AD NUMBER

ADB267627

NEW LIMITATION CHANGE

TO

Approved for public release, distribution unlimited

FROM

Distribution authorized to U.S. Gov't. agencies only; Proprietary Information; Oct 2000. Other requests shall be referred to US Army Medical Research and Materiel Command, 504 Scott Street, Fort Detrick, MD 21702-5012

AUTHORITY

USAMRMC ltr, 21 Feb 2003

AD_____

Award Number: DAMD17-96-1-6262

TITLE: Early Stage Breast Cancer in Older Women: Predictions and Outcomes of Therapy.

PRINCIPAL INVESTIGATOR: Ann B. Nattinger, MD, MPH

CONTRACTING ORGANIZATION: Medical College of Wisconsin
Milwaukee, Wisconsin 53226-0509

REPORT DATE: October 2000

TYPE OF REPORT: Annual

PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

NOTICE

USING GOVERNMENT DRAWINGS, SPECIFICATIONS, OR OTHER DATA INCLUDED IN THIS DOCUMENT FOR ANY PURPOSE OTHER THAN GOVERNMENT PROCUREMENT DOES NOT IN ANY WAY OBLIGATE THE U.S. GOVERNMENT. THE FACT THAT THE GOVERNMENT FORMULATED OR SUPPLIED THE DRAWINGS, SPECIFICATIONS, OR OTHER DATA DOES NOT LICENSE THE HOLDER OR ANY OTHER PERSON OR CORPORATION; OR CONVEY ANY RIGHTS OR PERMISSION TO MANUFACTURE, USE, OR SELL ANY PATENTED INVENTION THAT MAY RELATE TO THEM.

LIMITED RIGHTS LEGEND

Award Number: DAMD17-96-1-6262
Organization: Medical College of Wisconsin
Location of Limited Rights Data (Pages):

Those portions of the technical data contained in this report marked as limited rights data shall not, without the written permission of the above contractor, be (a) released or disclosed outside the government, (b) used by the Government for manufacture or, in the case of computer software documentation, for preparing the same or similar computer software, or (c) used by a party other than the Government, except that the Government may release or disclose technical data to persons outside the Government, or permit the use of technical data by such persons, if (i) such release, disclosure, or use is necessary for emergency repair or overhaul or (ii) is a release or disclosure of technical data (other than detailed manufacturing or process data) to, or use of such data by, a foreign government that is in the interest of the Government and is required for evaluational or informational purposes, provided in either case that such release, disclosure or use is made subject to a prohibition that the person to whom the data is released or disclosed may not further use, release or disclose such data, and the contractor or subcontractor or subcontractor asserting the restriction is notified of such release, disclosure or use. This legend, together with the indications of the portions of this data which are subject to such limitations, shall be included on any reproduction hereof which includes any part of the portions subject to such limitations.

THIS TECHNICAL REPORT HAS BEEN REVIEWED AND IS APPROVED FOR PUBLICATION.

Nwungha ceran Mann
05/23/01

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	October, 2000	Annual (15 Sept 99 - 14 Sept 00)

4. TITLE AND SUBTITLE
Early Stage Breast Cancer in Older Women: Predictions and Outcomes of Therapy

5. FUNDING NUMBERS
DAMD17-96-1-6262

6. AUTHOR(S)
Ann B. Nattinger, MD, MPH

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Medical College of Wisconsin
Milwaukee, Wisconsin 53226-0509

E-Mail: anatting@mcw.edu

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
This report contains colored photos

12a. DISTRIBUTION / AVAILABILITY STATEMENT
DISTRIBUTION STATEMENT: Distribution authorized to U.S. Government agencies only (proprietary information, Oct 00). Other requests for this document shall be referred to U.S. Army Medical Research and Materiel Command, 504 Scott Street, Fort Detrick, Maryland 21702-5012.

12b. DISTRIBUTION CODE

13. ABSTRACT ***(Maximum 200 Words)***

This study uses secondary data bases (SEER tumor registry records and Medicare claims data) to examine the relationship of primary breast cancer treatment to specific outcomes. We have found that the proportion of U.S. women with early stage breast cancer who are receiving appropriate care (defined by NIH Consensus statement) declined from 88% in 1983-89 to 78% by the end of 1995. This decline has occurred because the proportion of all women who were treated by breast-conserving surgery increased, and because women undergoing breast-conserving surgery are more likely to receive inappropriate care.

We have now shown that patients living 15 or more miles from a hospital with radiotherapy facilities are less likely than others to undergo BCS therapy. Women living 40 or more miles from a radiotherapy site are less likely than others to undergo radiotherapy after a BCS procedure. Although BCS has undergone substantial adoption during the 1900's, women of higher socioeconomic status and who reside in urban areas remain more likely to undergo BCS.

Compared to BCS patients who undergo radiotherapy, those BCS patients who do not undergo radiotherapy have a significantly elevated hazard ratio of treatment for recurrent disease. In addition, BCS patients who receive neither axillary lymph node dissection nor radiotherapy are at significantly higher risk of death, after adjusting for age, tumor size, and comorbid conditions.

14. SUBJECT TERMS	15. NUMBER OF PAGES
Breast Cancer	115
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

Table of Contents

1. Nattinger AB, Hoffmann RG, Kneusel RT, Schapira MM. Relationship between appropriateness of primary therapy for early-stage breast carcinoma and increased use of breast-conserving surgery. Lancet 2000;356:1148-53.

2. Nattinger AB, Kneusel RT, Hoffmann RG, Gilligan MA. Relationship of initial breast cancer treatment and distance from a hospital with radiotherapy facilities. 2000, in preparation for submission.

3. Du X, Freeman JL, Nattinger AB, Goodwin JS. Survival of women after breast-conserving surgery for early stage breast cancer. 2000, submitted for publication.

4. Gilligan MA, Kneusel RT, Hoffmann RG, Greer AL, Nattinger, AB. Persistent differences in socio-demographic determinant of use of breast-conserving surgery despite overall increased adoption. 2000, submitted for publication.

5. Du X, Freeman JL, Warrant JL, Nattinger AB, Zhang D, Freeman DH, Goodwin JS. Accuracy and completeness of Medicare Claims Data for surgical treatment of breast cancer. Med Care 2000;38:719-727.

6. Ann B. Nattinger's Curriculum Vitae.

4.) INTRODUCTION

Almost half of the incident cases of breast cancer occur in women aged 65 and older. However, patients in this age group are infrequently enrolled into randomized clinical trials and have been seriously under-represented in the randomized trials of breast-conserving surgery (BCS) vs mastectomy. The randomized trials of younger women suggest that receipt of BCS without radiotherapy is associated with an increased risk of local disease recurrence, but no definite decrease in overall survival.

The goal of this study is to study outcomes associated with different breast cancer treatments in a population-based observational cohort of women aged 65 and older who have undergone surgical treatment for early stage breast cancer. The specific aims are:

1. To develop algorithms to utilize Medicare inpatient and outpatient data to define and study the treatments received and outcomes associated with the use of BCS with or without radiotherapy and mastectomy among older women with early stage breast cancer.

2. To determine predictors of receipt of radiotherapy among older women with early stage breast cancer who have undergone BCS.

3. To determine specific outcomes, especially treatment for local/regional disease recurrence, associated with receipt of BCS with radiotherapy, BCS without radiotherapy, and mastectomy among older women with early stage breast cancer.

To accomplish these aims we proposed methods for using the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) tumor registry data and Medicare claims files.

5.) BODY

Specific Aim #2. Determine Predictors of Radiotherapy.

A. Lack of Radiotherapy and Lymph Node Dissection After BCS.

In last year's report, we submitted a manuscript regarding lymph node dissection and receipt of radiotherapy as components of quality of care for women undergoing breast-conserving surgery. At the time of last year's report, this work was in manuscript form. This work has now been published in the Lancet. (1) Please see the published article in the appendix for details of the methods, results, and discussion.

B. Distance from Radiotherapy Site.

During the year of this report, we have completed additional work evaluating the relationship of initial breast cancer treatment (receipt of breast-conserving surgery [BCS] and receipt of radiotherapy after BCS) to distance of patient residence to a hospital with radiotherapy facilities. The hypothesis was that greater distance from the patient's residence to a hospital with radiotherapy would be inversely related to use of BCS (as opposed to mastectomy) for primary surgical treatment, as well as a barrier to the use of radiotherapy among patients who have undergone BCS. Please see the manuscript in the appendix for details of the methods and results. (*Nattinger AB, Kneusel RT, Hoffmann RG, Gilligan MA. Relationship of Initial Breast Cancer Treatment and Distance from a Hospital with Radiotherapy Facility, 2000 submitted*). As noted in the discussion, patients living 15 or more miles from a hospital providing radiotherapy were substantially less likely than others to undergo BCS. The lesser use of BCS among these patients does not mean that they are undergoing inappropriate care, but these patients may not perceive BCS as a realistic option. Therefore, living 15 or more miles from a radiotherapy site appears to function as a barrier to choice of cancer treatment.

In addition, we have found that patients living 40 or more miles from a radiotherapy site were substantially less likely than others to undergo radiotherapy after a BCS procedure. This finding raises an appropriateness of care issue, as well as an access issue, for these patients. In the cohort of SEER patients whom we studied, few patients (about 2%) lived this great of a distance from a hospital with radiotherapy. However SEER patients are much less likely to reside in rural areas than the rest of the U.S. population, so this finding probably applies to a larger percentage of the entire U.S. population. Physicians caring for women who reside at a substantial distance from a radiotherapy site should be aware of this potential quality of care issue.

Specific Aim #3. Outcomes of Primary Therapies for Early Stage Breast Cancer.

A. Survival Among BCS Patients Not Undergoing Axillary Lymph Node Dissection or Radiotherapy.

This work shows that women who received neither axillary lymph node dissection nor radiotherapy were at significantly higher risk of death, compared to those undergoing both axillary dissection and radiotherapy, after adjusting for age, tumor size, and comorbid conditions. This work was summarized in last year's report, and the

manuscript is attached. *(Du X, Freeman JL, Nattinger AB, Goodwin JS. Survival of Women After Breast Conserving Surgery for Early Stage Breast Cancer, 2000, submitted for publication).*

B. Intermediate Outcomes After BCS without Radiotherapy.

In randomized trials, receipt of BCS without radiotherapy has been associated with a risk of local disease recurrence of about 35% after 5 years. [2] However these trials included few women aged 65 and older. As documented elsewhere in this report, we (and others) have found that 30-50% of older women undergoing BCS treatment do not undergo radiotherapy. Retrospective studies attempting to determine whether older women can safely be treated without radiotherapy have had conflicting results. The purpose of this study is to determine whether omission of radiotherapy after BCS adversely affects breast cancer outcomes in a cohort of women aged 65 and older.

In this study, we used the National Cancer Institute's SEER tumor registry records, which were linked to Medicare claims data for women aged 65 and older. The cohort selected for study included 2771 women who were aged 65 and older at the time of diagnosis of local or regional breast cancer in 1986 or 1987, for whom Medicare parts A & B claims were available for 6 years or until death, and who underwent initial surgery for the tumor. Of this cohort 78% underwent mastectomy and 22% underwent BCS. Of the BCS patients, 55% underwent radiotherapy and 45% did not.

The SEER tumor registry files include information on incident cancers, stage of disease, and initial treatment, but no information on disease recurrence or treatment of disease recurrence based on the Medicare claims data. This was a difficult analytic problem, discussed in detail in the last year's annual report, pp8-10. For the purposes of this study, disease recurrence was defined as a claim for mastectomy more than 6 months after diagnosis, radiotherapy more than 8 months after diagnosis, or chemotherapy more than 15 months after diagnosis. These cutoff dates are set conservatively, i.e., it is unlikely that initial treatment is occurring after the cutoff dates, but some treatment for recurrent disease may be occurring prior to the cutoff dates.

A cox proportional hazards model was constructed to predict disease recurrence based on treatment undergone: BCS without RT, BCS with RT, or mastectomy. The model was adjusted for patient age, stage of disease, race, and the zip code level economic indicators of per capita income and the percentage of adults in the zip code who had completed high school. The reference treatment category was BCS with RT.

Compared to the BCS patients who underwent RT, those who underwent BCS without RT had a significant hazard ratio of 1.52 (See Table 1). Women who underwent mastectomy did not have an increased hazard of disease recurrence. Women with regional stage disease also had an increased hazard of recurrences, as one would expect. Increasing age was somewhat protective against disease recurrence, presumably due to a competing risk of death from other causes.

Table 1. Association of Initial Treatment Undergone and Disease Recurrence, Based on Medicare Claims.

Factor	Hazard Ratio	95% CI
BCS without RT*	1.52	1.05 – 2.19
Mastectomy*	1.10	0.86 – 1.41
Stage (regional vs local)	1.72	1.45 – 2.03
Age at Dx (per year)	0.97	0.96 – 0.98

* Compared to a reference category of treatment with BCS with RT. Factors were also adjusted for race, zip code per capita income, and zip code educational level.

Given that our definition of disease recurrence is claims-based, we felt it important to check for face validity of this measure by studying disease recurrence as a predictor of death. The relation of disease recurrence and breast cancer specific mortality is presented in Table 2. As can be seen by the hazard ratio of > 8, disease recurrence as defined by our claims-based algorithm is an important predictor of breast cancer specific mortality. This analysis adjusts for age, race, stage, education and income level of the zip code of residence of the patient, and comorbidity.

Table 2. Relation of Disease Recurrence and Breast Cancer-Specific Mortality.

Factor*	Hazard Ratio	95% CI
Disease Recurrence	8.32	6.87 – 10.1
Age (per year)	1.02	1.01 – 1.04
Black Race (vs others)	1.95	1.33 – 2.87

* Also adjusted for stage, zip code per capita income, zip code education, and comorbidity (claims adaptation of Charlson comorbidity score).

This work is limited by the fact that disease recurrence was determined by Medicare treatment claims, and there may be misclassification. In particular, some women with disease recurrence may have been treated only with tamoxifen or other hormonal agents, which are not covered by Medicare. However, omission of RT after BCS should mainly be associated with an excess of local disease recurrences, and these are typically treated with surgical resection and/or RT, not with tamoxifen alone.

Specific Aim #1: Algorithms Using Medicare Data.

Most of the work on this specific aim has been completed, as reported in detail in previous annual reports, and as summarized in a publication. [3] Tasks 1-4 have been completed, and task #5 partially completed. We had hoped that Dr. Craig Beam would be able to work with us to determine if the application of another multivariate method (other than logistic regression, employed in reference 3) would permit the construction of a more robust algorithm for using Medicare data to determine breast cancer cases. Dr. Beam was unable to do so during this past year. Therefore, we have arranged for Dr. Prakash Laud to work with us in this area during our upcoming no-cost extension year.

Dr. Laud is an expert in Bayesian statistical methods, and he will add a great deal to our approach.

We have applied for, and been granted, a 1 year no-cost extension for this project. We will use this year to complete work on task 5, with respect to specific aim #1, and to complete work on tasks 10-12, with respect to specific aim #3. As reported in this report, tasks 6-9 are now completed, and tasks 10-12 are partially completed.

C. Temporal Trends in Use of BCS.

We have made substantial progress in work describing changing patterns in use of BCS over time. We attach a manuscript summarizing the predictors of receipt of BCS over the time period 1983-1995. *(Gilligan MA, Kneusel RT, Hoffmann RG, Nattinger AB. Persistent Differences in Socio-demographic Determinants of Use of Breast-Conserving Surgery Despite Overall Increased Adoption).*

6.) KEY RESEARCH ACCOMPLISHMENTS: (bolded items completed since previous report).

- Determination of agreement of SEER and Medicare data bases for surgical treatment of breast cancer.
- Determination of relative completeness of different types of Medicare claims for breast cancer operations recorded by SEER.
- Development of predictors of concordance between SEER and Medicare data bases.
- Determination of percentage receipt of appropriate care (BCS patients who have undergone radiation and axillary lymph node dissection and total mastectomy patients who have undergone axillary lymph node dissection) over time.
- Determination of predictors of appropriate care, in terms of age, urban vs rural residence, and type of surgery.
- Determination of predictors of axillary node dissection, relationship of receipt of axillary dissection to receipt of radiotherapy and relationships to survival, among BCS patients.
- **Determination of the relationship between breast cancer treatment received and distance a patient resides from a hospital with radiotherapy facilities.**
- **Finding that distance from patient residence to a hospital with radiotherapy does not account for geographic variation in use of BCS nor the geographic variation in use of radiotherapy after BCS.**
- **Finding of persistent variation in use of BCS by geography, urban-rural status, and socioeconomic status 10 years after the publication of the first U.S. randomized trial of BCS vs mastectomy.**
- Development of methodology for partitioning mastectomy, radiotherapy, and chemotherapy claims into initial therapy or therapy for recurrent disease.
- **Finding that claims-based methodology for determining breast cancer recurrence has face validity in terms of predicting breast cancer specific mortality.**

- **Finding that receipt of BCS without radiotherapy is associated with an elevated hazard of treatment for disease recurrence, among a cohort of breast cancer patients aged 65 and older.**

7.) REPORTABLE OUTCOMES:

Publications:

- Du X, Freeman JL, Warren JL, Nattinger AB, Zhang D, Freeman DH, Goodwin JS. Accuracy and completeness of Medicare claims data for surgical treatment of breast cancer. Med Care 2000, 38:719-727.

- Nattinger AB, Hoffmann RG, Kneusel RT, Schapira MM. Relationship between appropriateness of primary therapy for early-stage breast carcinoma and increased use of breast-conserving surgery. Lancet 2000, 356:1148-53.

- Du X, Freeman JL, Nattinger AB, Goodwin JS. The effect of axillary node dissection on survival in women with early stage breast cancer. 2000, submitted for publication.

- Nattinger AB, Kneusel RT, Hoffmann RG, Gilligan MA. Relationship of initial breast cancer treatment and distance from a hospital with radiotherapy facilities. 2000, in preparation for submission.

- Gilligan MA, Kneusel RT, Hoffmann RG, Greer AL, Nattinger AB. Persistent differences in socio-demographic determinants of use of breast-conserving surgery despite overall increased adoption. 2000, submitted for publication.

Presentations and Abstracts:

- Beam CA, Nattinger AB. Accuracy of inpatient Medicare claims for breast cancer therapy determination. Presented at the Department of Defense U.S. Army Medical Research and Materiel Command Breast Cancer Research Program Meeting: An Era of Hope. Oct 31-Nov 4, 1997, Washington, DC.

- Beam CA, Guse C, Nattinger AB. Do outpatient records improve the accuracy of Medicare breast cancer claims data? J Gen Intern Med 1998;13 (suppl):41. Presented at the Society of General Internal Medicine National Meeting, April 23-25, 1998, Chicago, IL.

- Nattinger AB, Hoffmann RG, Kneusel RT, Schapira MM. Decrease in appropriateness of breast cancer care associated with increased use of breast-conserving surgery. J Gen Intern Med 1999;14 (suppl 2):58. Presented at the 22nd Annual National SGIM meeting in San Francisco, CA, April 29-May 1, 1999.

- Nattinger AB, Hoffmann RG, Kneusel RT, Schapira MM. Outcomes associated with omission of radiotherapy after breast-conserving surgery, among older women with early stage breast cancer. JGIM 2000;15:87-88. Presented at the 23rd Annual SGIM meeting in Boston, MA. May 4-6, 2000.

- Gilligan M, Hoffmann RG, Kneusel RT, Nattinger AB. Determinants of use of breast-conserving surgery: Change over time. JGIM 2000;15:117. Presented at the 23rd Annual SGIM meeting in Boston, MA., May 4-6, 2000.

Grants Applied For:

- "Outcomes of Older Women with Early Stage Breast Cancer", PHS, National Cancer Institute R01 CA081379. July 1, 2000 – June 30, 2003, based in part on work supported by this award.

8.) CONCLUSIONS:

Between 1983 and 1995, substantial variation by geography and patient demographic factors persisted in the treatment of early stage breast cancer. Between 1983 and 1995, the percentage of women with early breast cancer who received care termed appropriate by the 1990 NIH consensus statement declined from 88% to 78%. This was due to a move away from mastectomy and toward more use of BCS. However, a sizable minority of women undergoing BCS fail to undergo either postoperative radiotherapy or axillary lymph node dissection. Omission of radiotherapy is related to long distance from patient residence to a hospital with radiotherapy services. However, distance from a radiotherapy facility does not explain the observed geographic variation in use of radiotherapy.

Older women who undergo BCS without radiotherapy have a greater risk than others of being treated for disease recurrence during the first five years after breast cancer diagnosis, based on claims-based markers for disease recurrence. Older women who undergo BCS without radiotherapy and without axillary lymph node dissection have poorer survival than expected, after adjusting for demographics, tumor size, and comorbid diseases.

9.) REFERENCES:

1. Nattinger AB, Hoffmann RG, Kneusel RT, Schapira MM. Relationship between appropriateness of primary therapy for early-stage breast carcinoma and increased use of breast-conserving surgery. Lancet 2000;356:1148-53.

2. Fisher B, Anderson S, Redmond C, Wolmark N, Wickerham DL, Cronin WM. Re-analysis and results after 12 years of follow-up in a randomized clinical trial comparing total mastectomy with lumpectomy with or without irradiation in the treatment of breast cancer. N Engl J Med 1995;333:1456-1461.

3. Du X, Freeman JL, Warren JL, Nattinger AB, Zhang D, Freeman DH, Goodwin JS. Accuracy and completeness of Medicare Claims Data for surgical treatment of breast cancer. Med Care 2000;38:719-727.

10.) APPENDICES:

1. Nattinger AB, Hoffmann RG, Kneusel RT, Schapira MM. Relationship between appropriateness of primary therapy for early-stage breast carcinoma and increased use of breast-conserving surgery. Lancet 2000;356:1148-53.

2. Nattinger AB, Kneusel RT, Hoffmann RG, Gilligan MA. Relationship of initial breast cancer treatment and distance from a hospital with radiotherapy facilities. 2000, in preparation for submission.

3. Du X, Freeman JL, Nattinger AB, Goodwin JS. Survival of women after breast-conserving surgery for early stage breast cancer. 2000, submitted for publication.

4. Gilligan MA, Kneusel RT, Hoffmann RG, Greer AL, Nattinger, AB. Persistent differences in socio-demographic determinant of use of breast-conserving surgery despite overall increased adoption. 2000, submitted for publication.

5. Du X, Freeman JL, Warrant JL, Nattinger AB, Zhang D, Freeman DH, Goodwin JS. Accuracy and completeness of Medicare Claims Data for surgical treatment of breast cancer. Med Care 2000;38:719-727.

6. Ann B. Nattinger's Curriculum Vitae.

Relation between appropriateness of primary therapy for early-stage breast carcinoma and increased use of breast-conserving surgery

Ann Butler Nattinger, Raymond G Hoffmann, Ronald T Kneusel, Marilyn M Schapira

Summary

Background Breast-conserving surgery is a more complex treatment than mastectomy, because a separate incision is needed for axillary lymph-node dissection, and postoperative radiotherapy is necessary. We postulated that adoption of this therapy into clinical practice might have led to discrepancies between the care recommended and that received.

Methods We used records of the US national Surveillance, Epidemiology, and End Results tumour registry to study 144 759 women aged 30 years and older who underwent surgery for early-stage breast cancer between 1983 and 1995. We calculated the proportion undergoing at least the minimum appropriate primary treatment (defined, in accordance with the recommendations of a National Institutes of Health Consensus Conference in 1990, as total mastectomy with axillary node dissection or breast-conserving surgery with axillary node dissection and radiotherapy) during each 3-month period.

Findings The proportion of women receiving appropriate primary therapy fell from 88% in 1983–89 to 78% by the end of 1995. This decline was observed in all subgroups of age, race, stage, and population density. Of all women in the cohort, the proportion undergoing an inappropriate form of mastectomy remained stable at about 2·7% throughout the study period. The proportion undergoing an inappropriate form of breast-conserving surgery (omission of radiotherapy, axillary node dissection, or both) increased from 10% in 1989 to 19% at the end of 1995.

Interpretation Although most women undergo appropriate care, the appropriateness of care for early-stage breast cancer in the USA declined from 1990 to 1995. Because the proportion of all women who were treated by breast-conserving surgery increased, and because this approach was more likely than was mastectomy to be applied inappropriately, the proportion of all women having inappropriate care increased.

Lancet 2000; **356:** 1148–53
See Commentary page 1124

Departments of Medicine (A Butler Nattinger MD, R T Kneusel MS, M M Schapira MD) **and Biostatistics** (R G Hoffmann PhD), **Medical College of Wisconsin, Milwaukee, WI, USA**

Correspondence to: Dr Ann Butler Nattinger, Division of General Internal Medicine, FEC Medical Office Building, Suite 4200, 9200 West Wisconsin Avenue, Milwaukee, WI 53226, USA

Introduction

In June, 1990, a Consensus Development Conference organised by the National Institutes of Health held that either breast-conserving surgery or total mastectomy was appropriate for most women with stage I or II breast cancer. This consensus statement also clarified that either operation should include axillary lymph-node dissection, and that breast-conserving surgery should be accompanied by radiotherapy.[1] Breast conservation was judged preferable to mastectomy[1] but is arguably more complex. Breast conservation requires a separate incision for axillary lymph-node dissection, postoperative radiotherapy, attention to the tumour margins, and attention to the cosmetic result.[2]

The use of breast-conserving surgery increased during the early 1980s,[3] remained generally stable during the late 1980s,[4,5] and increased further from about 1990 onwards.[6–10] Adoption of a more complex therapy into clinical practice might be expected to lead to some discrepancy between the care recommended and that delivered. For example, not all women undergoing breast-conserving surgery receive radiotherapy.[3,10,11]

In this study, we assessed the use of appropriate primary therapy, as recommended by the 1990 consensus conference, over the period 1983–95.

Methods

Patients

The National Cancer Institute Surveillance, Epidemiology, and End Results (SEER) registry[12] was the source of data on breast-cancer patients and their care. The SEER data were collected by nine geographically distinct population-based tumour registries; the registry included information on demographic characteristics, extent of disease, and initial treatment for about 10% of US cancer patients. The nine SEER sites included are the entire states of Connecticut, Hawaii, Iowa, New Mexico, and Utah, and the metropolitan areas of Atlanta, Detroit, Seattle–Puget Sound, and San Francisco–Oakland.

To characterise the study population further, we obtained from the federal Area Resource File[13] information on the urban or rural status of the county of residence of the patient.

We initially selected 147 432 women aged 30 years or older at the time of first diagnosis of an invasive local or regional unilateral breast cancer between 1983 and 1995. We have used similar methods previously.[6,7] We excluded 1887 (1·3%) women who did not undergo primary breast-conserving surgery or mastectomy or whose type of surgery was unknown and 55 women (0·04%) whose date of diagnosis was unknown. These exclusions left a cohort of 145 490 women.

Definitions of analytical variables

Based on SEER convention, the cancer was classified as local if it was confined to the breast tissue and regional if it had extended into surrounding tissue or regional lymph nodes. The more precise American Joint Committee on

between 12 and 37%.[2,17-20] We have not included cases of hypoplastic left ventricle associated with other complex cardiac anomalies (29 cases over 6 years) to ensure a homogeneous group for study. When possible necropsies were done to confirm diagnosis and exclude any associated syndromes. However, the necropsy uptake rate was not high, either in deaths close to surgery or some time beyond. Potentially useful information from necropsies has been reported.[21]

An obstetric policy of induction of labour between 38 and 40 weeks' gestation was applied, to enable delivery to coincide with the availability of both neonatal and paediatric intensive care cots. Most mothers achieved vaginal delivery; this is in accordance with Reis and colleagues[18] finding that babies with HLHS tolerate labour well. Only two of our mothers required an emergency caesarean section for fetal distress in labour. However, we noted a higher frequency of preterm delivery, of which over half were spontaneous preterm labour. Prematurity was associated with a poorer outcome for babies with HLHS, with none of these babies surviving. Intrauterine growth restriction was not associated with HLHS, although three babies weighed less than 2·5 kg at term. All these had extracardiac anomalies or were a multiple pregnancy. Only one of these three babies survived the stage-1 Norwood procedure.

The poor prognosis for prenatally diagnosed HLHS should be explained to parents at initial referral to the fetal medicine unit to ensure that they are in a position to make a fully informed decision about future management of the disorder. Babies must be delivered in a unit with adequate neonatal facilities to manage a prostaglandin E2 infusion and possible ventilation during transfer. Many units, including our own, advise transfer of care in the late prenatal period and delivery in the hospital adjacent to the cardiothoracic centre. However, the effect of possible improved preoperative condition on survival is not clear.[22-25] Delivery near the cardiothoracic centre could facilitate communication between health-care professionals and lessen the chance of separation of mother and baby in the neonatal period. However, this advantage has to be balanced against the social strain of delivering away from home, friends, and the support of family members.

We believe these data allow a stepwise process of diagnosis and assessment that will aid health-care workers and parents in decision making during the prenatal period. Certainly a global survival figure for this congenital anomaly is not appropriate.[8] As with many congenital anomalies identified prenatally, the prognosis to give parents should not be drawn from paediatric experience, but from studies like ours. Thus, despite encouraging survival figures from postnatal diagnoses, it is important that the risk calculations for prenatal counselling are based on data with an appropriate denominator. HLHS presents a great challenge to the health-care professionals involved in its management.

Contributors

Mark Kilby instigated this study. Karen Brackley and Mark Kilby collected and analysed the data. All investigators were clinically involved with these patients. Mark Kilby, Martin Whittle, and Karen Brackley did the ultrasound examinations, John Wright and Oliver Stumper did the prenatal and postnatal echocardiographical examinations, and Bill Braun and B Sethia operated on these patients. Mike Wyldes coordinated the cross-collection of data from the West Midlands Congenital Anomaly Register and Roger Holder gave invaluable statistical help in analysing the data. All investigators helped write the manuscript.

Acknowledgments

The investigators thank the consultant obstetricians, radiologists and radiographers at the Birmingham Women's Hospital, and all healthcare professionals from referring hospitals and regional cardiothoracic centres that have aided confirmation of outcomes. We also thank Ann Tonks at the West Midlands Perinatal Audit for the collaboration, and Lida Debono and Lynn North, senior radiographers in the ultrasound department, and Ruth Kirchmeier, senior midwife. These data have also been presented to the Left Heart Matters Charity and in particular S Hutchinson.

References

1 Fyler DC. Report of the New England Regional Infant Cardiac Program. *Pediatrics* 1980; **65** (suppl): 377–461.
2 Noonan JA, Nadas AS. The hypoplastic left heart syndrome: an analysis of 101 cases. *Pediatr Clin North Am* 1958; **5:** 1029–56.
3 Allan LD, Sharland GK, Tynan M. Natural history of hypoplastic left heart syndrome. *Int J Cardiol* 1989; **25:** 341–43.
4 Allan LD, Sharland GK, Milburn A, et al. Prospective diagnosis of 1006 consecutive cases of congenital heart disease in the fetus. *J Am Coll Cardiol* 1994; **23:** 1452–58.
5 Bull C. Current and potential impact of fetal diagnosis on prevalence and spectrum of serious congenital heart disease at term in the UK. *Lancet* 1999; **354:** 1242–47.
6 Allan LD, Cook A, Sullivan I, et al. Changing birth prevalence of the hypoplastic left heart syndrome as a result of fetal echocardiography. *Lancet* 1991; **337:** 959–63.
7 Norwood WI, Kiklin JK, Sanders SP. Hypoplastic left heart syndrome: experience of palliative surgery. *Am J Cardiol* 1980; **45:** 87–91.
8 O'Kelly SW, Bove EL. Hypoplastic left heart syndrome. *BMJ* 1997; **314:** 87–88.
9 Bu'Lock FA, Stumper O, Jagtap ED, et al. Surgery for infants with a hypoplastic systemic ventricle and severe outflow obstruction: early results with a modified Norwood procedure. *Br Heart J* 1995; **73:** 456–61.
10 Ishino K, Stumper O, De Giovanni JJV, et al. The modified Norwood procedure for hypoplastic left heart syndrome: early to intermediate results of 120 patients with particular reference to aortic arch repair. *J Thorac Cardiovasc Surg* 1999; **117:** 920–30.
11 Allan LD, Apfel HD, Printz BF. Outcome after prenatal diagnosis of the hypoplastic left heart syndrome. *Heart* 1998; **79:** 371–74.
12 Whittle MJW. Routine ultrasound screening in pregnancy. Proceeding of the Royal College of Obstetricians and Gynaecologists Working party report 2000.
13 Montana E, Khoury MJ, Cragen JD. Trends and outcomes of prenatal diagnosis of congenital cardiac malformations by fetal echocardiography in a well defined birth population, Atlanta, Georgia. *J Am Coll Cardiol* 1996; **28:** 1805–09.
14 Howe DT, Kilby MD, Sirry H, et al. Structural chromosome anomalies in congenital diaphragmatic hernia. *Prenat Diagn* 1996; **16:** 1003–09.
15 Brace V, Grant SR, Brackley KJ, Kilby MD, Whittle MJ. Antenatal diagnosis and outcome of sacrococcygeal teratomas: a review of cases between 1992 and 1998. *Prenatal Diagn* 2000; **20:** 51–55.
16 Van Egmond H, Orye E, Praet M, Coppens M, Devloo-Blancquaert A. Hypoplastic left heart syndrome and 45X karyotype. *Br Heart J* 1988; **60:** 69–71.
17 Natowicz M, Chatten J, Clancy R, et al. *Pediatrics* 1988; **82:** 698–706.
18 Reis PM, Punch MR, Bove EL, van de Van CJM. Obstetric management of 219 infants with hypoplastic left heart syndrome. *Am J Obstet Gynecol* 1998; **179:** 1150–54.
19 Greenwood RD, Rosenthal A, Parisi L, Fyler DC, Nadas AS. Extracardiac anomalies in infants with congenital heart disease. *Pediatrics* 1975; **55:** 485–92.
20 Wallgren EI, Landtman B, Rapola J. Extracardiac malformations associated with congenital heart disease. *Eur J Cardiol* 1978; **7:** 15–24.
21 Bartrum U, Grunenfelder J, van Praagh R. Causes of death after modified Norwood procedures: a study of 122 postmortem cases. *Annals of Thoracic Surgery* 1997; **64:** 1795–802.
22 Chang AC, Huhta YC, Yoon GY, et al. Diagnosis, transport, and outcome in fetuses with left ventricular outflow tract obstruction. *J Thorac Cardiovasc Surg* 1991; **102:** 841–48.
23 Kern JH, Hayes CJ, Michler RE, Gersony WM, Quaegebeur JM. Survival and risk factor analysis for the Norwood procedure for the hypoplastic left heart syndrome. *Am J Cardiol* 1997; **80:** 170–74.
24 Kumar RK, Newburger JW, Gauvreau K, Kamenir SA, Hornberger LK. Comparison of outcome when hypoplastic left heart syndrome and transposition of the great arteries are diagnosed prenatally versus when diagnosis of these two conditions is made only postnatally. *Am J Cardiol* 1999; **83:** 1649–53.
25 Munn MB, Brumfield CG, Lau Y, Calvin EV. Prenatally diagnosed hypoplastic left heart syndrome—outcomes after postnatal surgery. *J Mat Fed Med* 1999; **8:** 147–50.

Cancer staging was not recorded until 1988, so could not be used for the primary analyses. That staging and tumour size information were used for a subgroup analysis of women treated in 1998 or later.

Patients were classified by SEER as having received breast-conserving surgery if they underwent segmental mastectomy, lumpectomy, quadrantectomy, tylectomy, wedge resection, excisional biopsy, or partial mastectomy. All other women underwent some form of mastectomy. Patients were classified as having had radiotherapy if they received any form of radiotherapy according to SEER and as not having had radiotherapy if SEER recorded them as undergoing no radiotherapy or refusing radiotherapy.

The patients were grouped by age at diagnosis (30–49 years, 50–64 years, 65–79 years, 80 years and older). Race was classified as white, black, or other. The size of metropolitan statistical area (MSA) of the county of residence was classified as fewer than 250 000 individuals or 250 000 or more individuals. For 85 (0·06%) of the patients, no valid code for county of residence was available. Such patients were excluded from analyses of urban versus rural status but were included in other analyses.

On the basis of the 1990 consensus conference,[1] the minimum requirements for appropriate primary therapy were defined as total mastectomy with axillary lymph-node dissection or breast-conserving surgery with axillary lymph-node dissection and radiotherapy. Women who underwent subcutaneous mastectomy, total mastectomy without lymph-node dissection, breast-conserving surgery without radiotherapy, or breast-conserving surgery without lymph-node dissection were classified as not meeting the consensus standard. For 731 (0·5%) of the 145 490 women, we could not assess whether care met the standard, because we could not find out whether they had undergone radiotherapy. The final study cohort consisted of the 144 759 women for whom appropriateness of care could be assessed.

Analysis

The study period was divided into 3-month periods. Each patient was assigned to one of these periods on the basis of her month and year of diagnosis. For each period, the proportion of women who received appropriate therapy was calculated, with the denominator consisting of all cohort patients treated during that time. Unadjusted proportions are plotted in the figures.

A multivariate logistic model was constructed to allow adjustment of the probability of appropriate therapy for differences in age of patient, stage of disease, race, or size of the MSA in which the patient lived. Time for each patient was recorded as month of diagnosis. Trends in treatment over time measured in months were modelled with a logistic spline function,[14] which allowed knots (linear rate changes in the underlying model for appropriateness with time) at the beginning of the year. In addition, knots were allowed every 6 months from 1989 to 1991, around the time of the consensus conference. A forward stepwise regression analysis was used to include only the knots that were significant. This approach produced a piecewise linear logistic fit to the underlying time trend with potential differences for each covariate. Each covariate was fitted separately to allow interactions between the covariates and time.

Using the multivariate model, we calculated the odds ratio for receipt of appropriate care in 1995 compared with 1989, with adjustment for age, race, stage, and size of MSA. Because inappropriate care is not a rare event in this cohort, the odds ratio is a biased estimate of the relative risk. Therefore, we corrected the adjusted odds ratios and CI to estimate the adjusted relative risk more precisely.[15]

Results

65·0% of the patients had local stage disease (table). Most were white and most lived in urban areas. There were increasing numbers of breast-cancer patients over time. Overall, 32·7% of the patients underwent breast-conserving surgery; the remainder had mastectomy. As found previously,[6–9] the use of breast-conserving surgery increased from 1983 to 1985, was stable until mid-1990, then increased steadily until 1995 (figure 1).

The unadjusted proportion of women in the cohort receiving appropriate primary therapy was about 88% until the late 1980s (figure 1); it then decreased to about 78% by the end of 1995. The multivariate model, which adjusted for age, race, stage, and size of MSA, showed a consistent decrease in the proportion receiving appropriate care from the second half of 1990 to 1995. For the cohort overall, the adjusted relative risk of receipt of appropriate therapy in 1995 compared with 1989 (the last year before the decline began) was 0·91 (95% CI 0·90–0·93).

To assess whether this decline in the proportion receiving appropriate care was restricted to certain subgroups of patients, we examined the annual rate of decrease from 1989 to 1995 overall, and for each subgroup of age, race, stage of disease, and size of the MSA in which the patient lived. The adjusted relative risk of receiving appropriate care in each year, compared with the previous year was 0·987 (0·986–0·988). There was a significant annual decrease in the risk of receiving appropriate care for each subgroup, with annual relative risks ranging from 0·980 to 0·994 for the various subgroups. Although each subgroup had a significant decline, the falls were smaller in women aged 80 years and older than in younger women ($p<0·0001$), and in women living in less urban areas than in women living in more urban areas ($p<0·0001$). In addition, each SEER site also had a significant annual decrease in the relative risk of receiving appropriate care.

To assess whether the consensus recommendations were being applied selectively on the basis of prognosis, we calculated the proportion receiving appropriate care

Characteristic	Number of patients	Characteristic	Number of patients
Age (years)		**Stage of disease**	
30–49	34 978 (24·2%)	Local	94 167 (65·0%)
50–64	45 870 (31·7%)	Regional	50 592 (35·0%)
65–79	48 855 (33·7%)	**Year of diagnosis**	
≥80	15 056 (10·4%)	1983	8647 (6·0%)
Race		1984	9179 (6·3%)
White	126 363 (87·3%)	1985	10 037 (6·9%)
Black	10 321 (7·1%)	1986	10 525 (7·3%)
Other	7332 (5·1%)	1987	11 421 (7·9%)
Unknown	743 (0·5%)	1988	11 370 (7·8%)
SEER site		1989	10 996 (7·6%)
San Francisco	24 681 (17·0%)	1990	11 664 (8·1%)
Connecticut	23 657 (16·3%)	1991	12 034 (8·3%)
Detroit	25 042 (17·3%)	1992	12 086 (8·4%)
Hawaii	5830 (4·0%)	1993	11 996 (8·3%)
Iowa	19 350 (13·4%)	1994	12 313 (8·5%)
New Mexico	7180 (5·0%)	1995	12 491 (8·6%)
Seattle	20 832 (14·4%)	**Surgical treatment**	
Utah	7107 (4·9%)	Mastectomy	97 481 (67·3%)
Atlanta	11 080 (7·7%)	Breast-conserving surgery	47 278 (32·7%)
Size of MSA (number of people)			
<250 000	30 115 (20·8%)		
≥250 000	114 599 (79·2%)		

Characteristics of study population

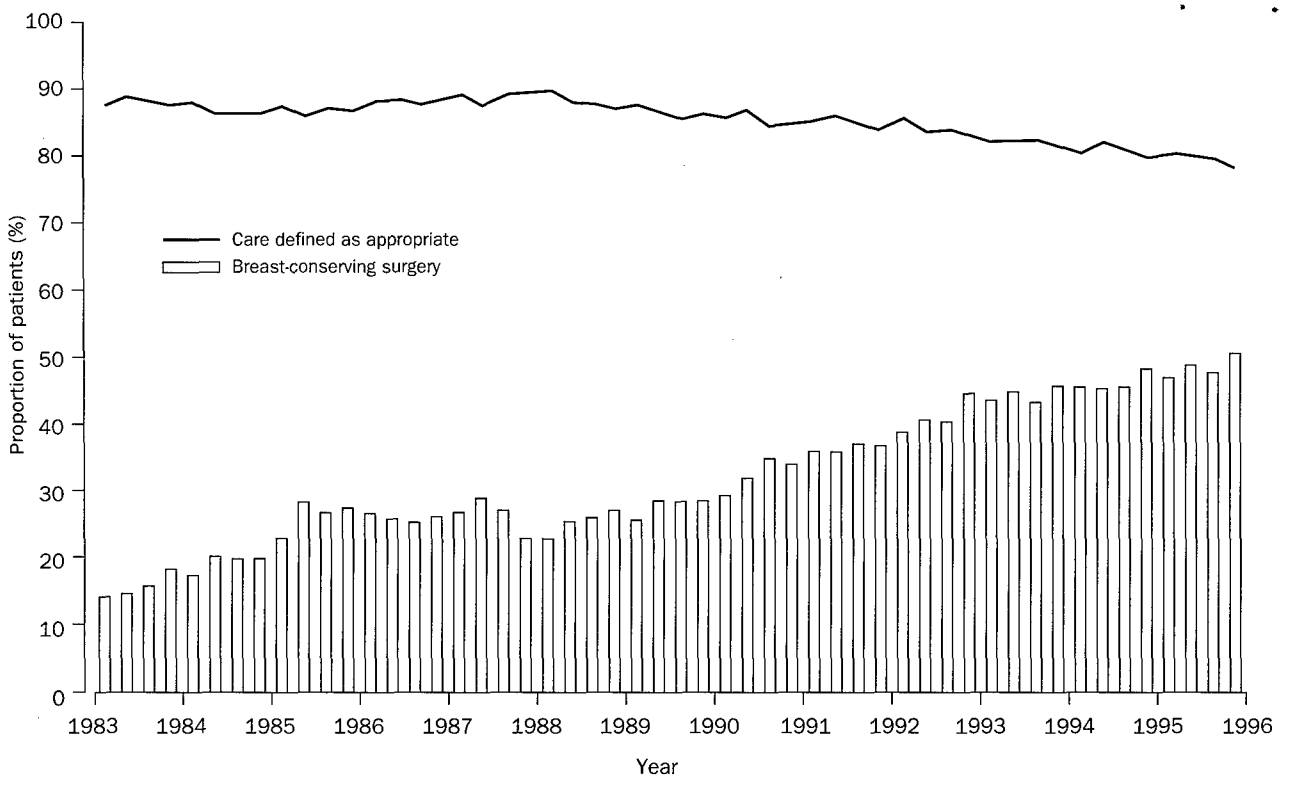


Figure 1: **Use of breast-conserving surgery and use of therapy defined as appropriate in the study population**

based on tumour size. Information on tumour size was available only from 1988, so we restricted these analyses to women diagnosed from 1988 to 1995. Among 45 540 women with stage I disease, those with tumours of 0–10 mm and 11–20 mm in diameter did not differ (p=0·09) in terms of decline in use of appropriate therapy.

We postulated that the decrease in the proportion of patients receiving appropriate therapy was associated with increased use of breast-conserving surgery. Of all patients in the cohort, the proportion of patients undergoing mastectomy treatment that did not meet the standard (total mastectomy without lymph-node dissection or

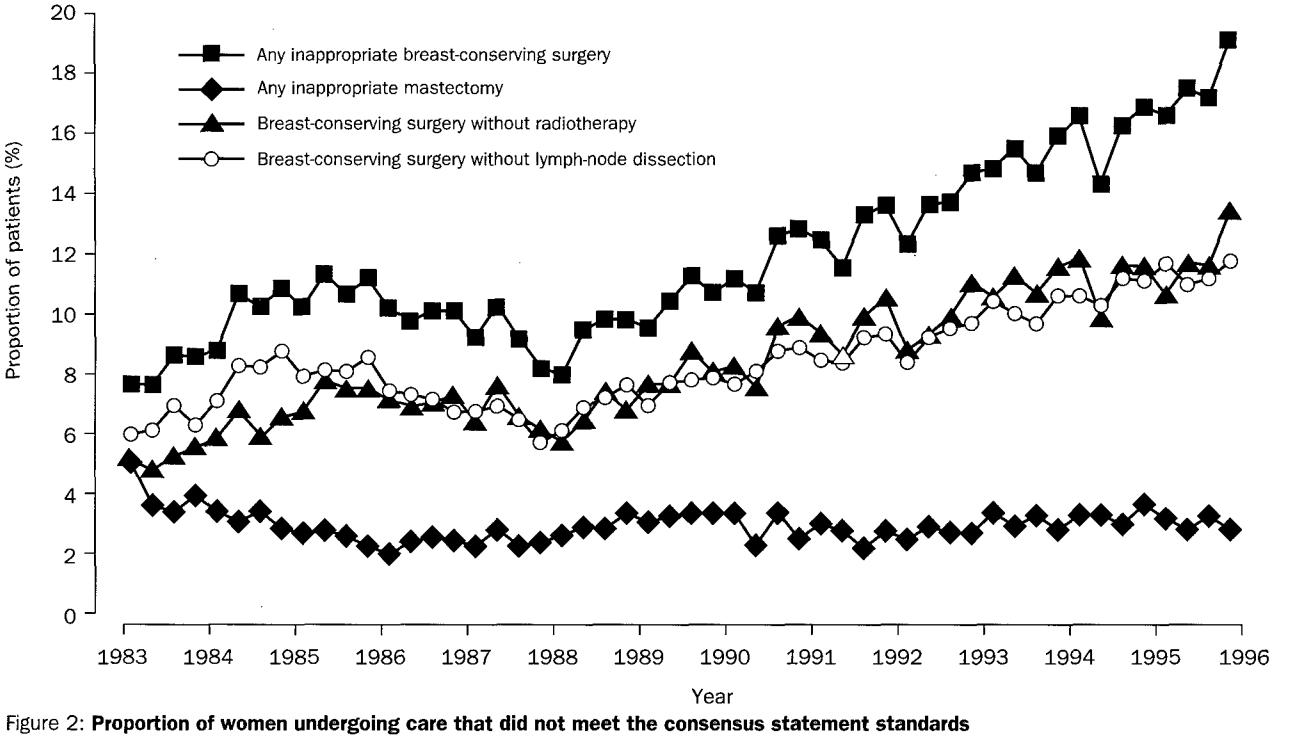


Figure 2: **Proportion of women undergoing care that did not meet the consensus statement standards**
Proportions undergoing breast-conserving surgery without radiotherapy and without axillary lymph-node dissection add to more than the total undergoing any inappropriate breast-conserving surgery because some women underwent neither. The denominator includes 144 759 women diagnosed with local or regional breast cancer from 1983 to 1995, who underwent either mastectomy or breast-conserving surgery.

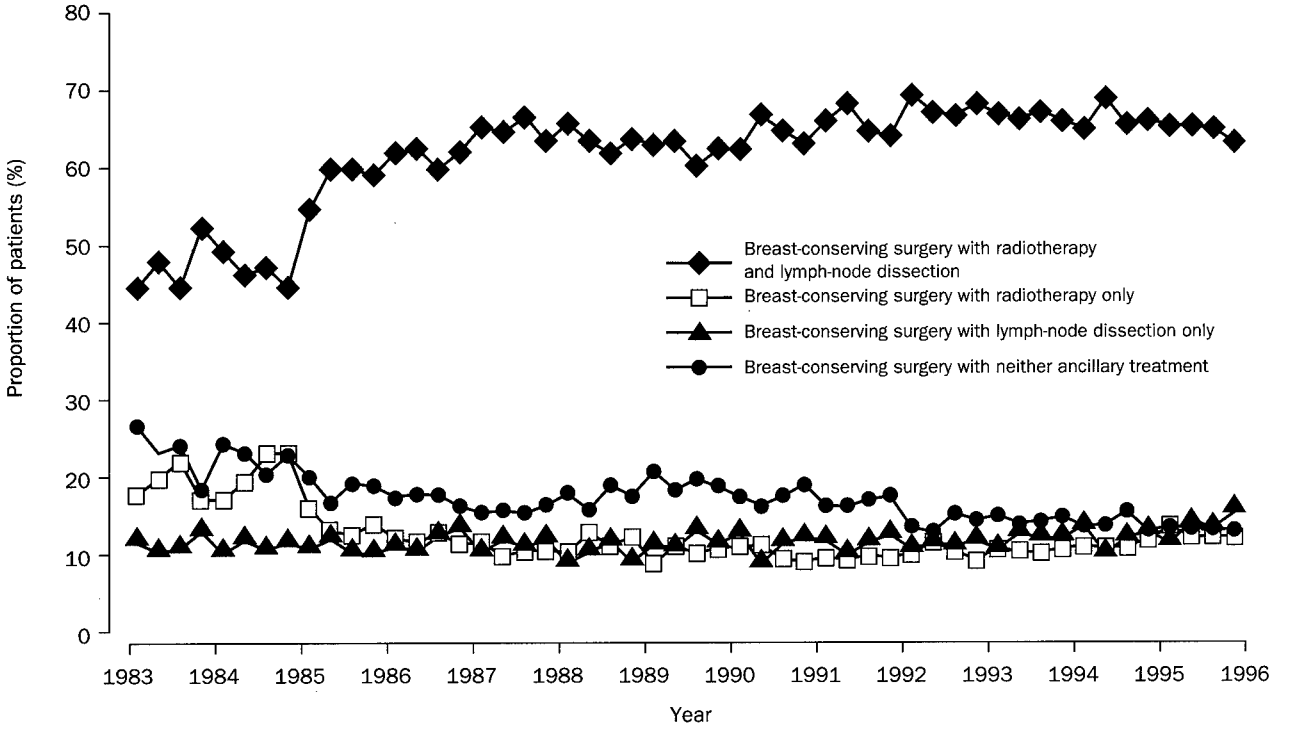


Figure 3: **Proportion of patients undergoing breast-conserving surgery who received both radiotherapy and axillary lymph-node dissection, only one ancillary treatment, or neither**
Denominator is 47 278 women diagnosed with local or regional breast cancer from 1983 to 1995 who underwent breast-conserving surgery as primary therapy.

subcutaneous mastectomy) remained stable at about 2·7% throughout most of the study period (figure 2). By contrast, the proportion of the total cohort undergoing breast-conserving surgery that did not meet the standard (no radiotherapy, no axillary node dissection, or neither) rose from about 10% in 1989 to almost 19% at the end of 1995. About equal proportions of women underwent care that was judged inappropriate because radiotherapy was omitted and because axillary node dissection was omitted.

We further postulated that the decrease in appropriateness of care was related to a decrease over time in the proportion of patients undergoing breast-conserving surgery who received radiotherapy or lymph-node dissection. However, among the women undergoing breast-conserving surgery, the proportion who received radiotherapy and axillary node dissection increased during the mid-1980s and remained stable at about 65% during the 1990s (figure 3). Therefore the decrease in the proportion of patients in the entire cohort undergoing appropriate treatment was related to the overall increase in the use of breast-conserving surgery and was not attributable to a decrease in the proportion of the patients who underwent breast-conserving surgery and received radiotherapy and lymph-node dissection (figure 3). Of the women who underwent breast-conserving surgery, roughly equal proportions did not receive radiotherapy, axillary node dissection, and neither ancillary treatment by 1995.

Although the number of women treated each year for breast cancer in this cohort increased 13·6% from 1989 to 1995 (from 10 996 women in 1989 to 12 491 women in 1994), the number of women each year who received conservative treatment that did not satisfy the consensus guideline nearly doubled over the same period (from 1158 women in 1989 to 2207 women in 1995).

Discussion

We have shown a decrease in the appropriateness of primary therapy for early-stage breast cancer during the period 1990 to 1995, as judged against the 1990 US National Institutes of Health Consensus Statement. The decline occurred in all subgroups based on age, stage of disease, and race. It was more pronounced among women living in more urban areas, probably because such women are more likely to undergo breast-conserving surgery.[4,10,16]

The decrease in the overall proportion of women who received appropriate care is attributable to increased use of breast-conserving surgery during the early 1990s. We emphasise that the proportion of patients treated conservatively who received appropriate care did not change during this time. Rather, there has been a substitution of a newer therapy, breast-conserving surgery for the previously dominant mastectomy therapy. Because breast-conserving surgery is not carried out according to the consensus standards in a substantial minority of patients, and mastectomy therapy is carried out according to consensus standards in the vast majority of cases, there has been a decrease overall in the likelihood that on average patients will receive appropriate therapy.

Some physicians or patients might disagree with the consensus statement recommendations for use of radiotherapy and axillary node dissection in certain subgroups of patients (eg, those at very low risk). However, the decline in appropriateness was found in all subgroups examined, which does not support such disagreement as an explanation for our findings. Patients are diverse, and consensus panel recommendations cannot be expected to be applied rigidly to everyone. Therefore, that 100% of women did not undergo therapy meeting the consensus standard is not surprising. What is surprising, however, is that the proportion of the population meeting the standard declined in the years immediately after the consensus conference. The SEER

sites we studied include about 10% of the US population, so our results suggest that more than 22 000 women each year may be receiving initial care that does not meet the consensus standard.

Women treated with breast-conserving surgery who do not receive radiotherapy have local recurrence rates of about 35% after 5 years.[17–20] Although such recurrences did not influence survival in the randomised trials of breast-conserving surgery, the use of this approach without radiotherapy has been associated with higher mortality in two population-based observational studies.[21,22] In addition, local disease recurrence is psychologically devastating for many women. Some may argue that patients with small tumours and stage I disease who are treated with breast-conserving surgery do not need radiotherapy. However, we are aware of no authorative group that has recommended against the use of postoperative radiotherapy in any subgroup of women treated with breast-conserving surgery.[23]

Some groups of researchers have questioned the need for axillary dissection for patients with small tumours, owing to lower risk of metastatic disease.[24,25] Clinical examination is, however, a poor predictor of axillary lymph-node involvement.[24,26]

In fact, among the 18 837 women in this cohort who had tumours 10 mm or smaller in diameter and underwent axillary lymph-node dissection, 2435 (12·9%) had one or more positive lymph nodes; and among 31 035 with tumours of 11–20 mm in diameter, 8868 (28·6%) had one or more positive nodes. Thus, there is a substantial risk of positive lymph nodes in women with small tumours. These findings are similar to those of others.[24,26,27]

Some researchers have proposed that axillary dissection can be omitted if adjuvant chemotherapy would be given anyway, assuming that axillary radiation would be used to provide local control of axillary disease.[24,25,28] However, of the patients in our cohort who underwent breast-conserving surgery without axillary dissection, only 41% had any radiotherapy, and presumably not all of those received axillary radiotherapy. Although findings of randomised trials suggest that axillary dissection does not improve survival,[29,30] one study in which use of axillary dissection led to greater use of adjuvant chemotherapy found improved survival.[31]

Some women who did not undergo axillary node dissection may have had sentinel lymph-node biopsy.[32] However, this procedure is not accepted as the standard of care;[33] during the years of this study, SEER personnel believe that the use of this procedure among SEER patients was infrequent (personal communication, April Fritz, SEER Quality Assurance).

A limitation of this study is that the SEER registries collect data only on treatments started within 4 months of the initial treatment. Therefore, some women may have undergone radiotherapy that was not included in the registry data because it was delayed until after chemotherapy. However, our finding that the decline in appropriateness was of similar size among the women least likely to undergo chemotherapy (stage I disease with tumours ≤10 cm in diameter) does not support delayed radiotherapy as the major explanation for our findings. The available data suggest that the SEER radiotherapy field is more than 90% accurate,[3,34] and our findings on use of radiotherapy generally accord with those of other investigators.[10,35] The SEER cohort offers the advantages of a large and diverse group of patients for study,[36] a population-based cohort, and recognised high overall quality of data-collection procedures.

Our results raise concern about translation of breast-conserving therapy into clinical practice in the 1990s. Although most women do receive appropriate care, a return to the appropriateness levels of the late 1980s would require a substantial increase in adherence to the consensus standard for use of radiotherapy and axillary node dissection in women undergoing breast-conserving surgery. These findings highlight the need for careful study of the use and outcomes of new therapies as they are adopted into practice.

Contributors

All the investigators contributed to the design of the study and analysis of the results. Raymond Hoffmann was primarily responsible for developing the multivariate analysis, with input from the other investigators. Ann Butler Nattinger drafted the report, and all the investigators contributed to editing.

Acknowledgments

We thank Susan Goodman for assistance with preparation of the report. This study was supported by a grant from the Department of Defense (DAMD17-96-1-6262).

References

1 Treatment of early-stage breast cancer: consensus statement. NIH Consensus Development Conference, June 18–21, 1990, vol 8, no 6. Bethesda, MD: National Institutes of Health, 1990.
2 Winchester DP, Cox JD. Standards for breast-conservation treatment. American College of Radiology, American College of Surgeons, College of American Pathologists, and Society of Surgical Oncology. *CA Cancer Clin* 1992; **42:** 134–62.
3 Mann BA, Samet JM, Hunt WC, Key CR, Goodwin JM, Goodwin JS. Changing treatment of breast cancer in New Mexico from 1969 through 1985. *JAMA* 1988; **259:** 3413–17.
4 Nattinger AB, Gottlieb MS, Hoffman RG, Walker AP, Goodwin JS. Minimal increase in use of breast-conserving surgery from 1986 to 1990. *Med Care* 1996; **34:** 749–89.
5 Lazovich DA, White E, Thomas DB, Moe RE. Underutilization of breast-conserving surgery and radiation therapy among women with stage I or II breast cancer. *JAMA* 1991; **266:** 3433–38.
6 Nattinger AB, Hoffmann RG, Shapiro R, Gottlieb MS, Goodwin JS. The effect of legislative requirements on the use of breast-conserving surgery. *N Engl J Med* 1996; **335:** 1035–40.
7 Nattinger AB, Hoffman RG, Howell-Pelz A, Goodwin JS. Effect of Nancy Reagan's mastectomy on choice of surgery for breast cancer by US women. *JAMA* 1998; **279:** 762–66.
8 Lazovich D, White E, Thomas D, Moe R, Taplin S. Change in the use of breast-conserving surgery in Western Washington after the 1990 NIH Consensus Development Conference. *Arch Surg* 1997; **132:** 418–23.
9 Riley GF, Potosky AL, Klabunde CN, Warren JL, Ballard-Barbash R. Stage at diagnosis and treatment patterns among older women with breast cancer. *JAMA* 1999; **281:** 720–26.
10 Lazovich D, Solomon CC, Thomas DB, Moe RE, White E. Breast conservation therapy in the United States following the 1990 National Institutes of Health consensus development conference on the treatment of patients with early stage invasive breast carcinoma. *Cancer* 1999; **86:** 628–37.
11 Ballard-Barbash R, Potosky AL, Harlan LC, Nayfield SG, Kessler LG. Factors associated with surgical and radiation therapy for early stage breast cancer in older women. *J Natl Cancer Inst* 1996; **88:** 716–26.
12 Surveillance, Epidemiology, and End Results (SEER) Program Public-Use CD-ROM (1973–1995), National Cancer Institute, DCPC, Surveillance Program, Cancer Statistics Branch, released April 1998, based on the August 1997 Submission.
13 Bureau of Health Professions. The Area Resource File (ARF) system: information for health resources planning and research. Washington, DC: Government Printing Office, 1992.
14 Pastor R, Guallar E. Use of two-segmented logistic regression to estimate change-points in epidemiologic studies. *Am J Epidemiol* 1998; **148:** 631–42.
15 Zhang J, Yu KF. What's the relative risk? A method of correcting the odds ratio in cohort studies of common outcomes. *JAMA* 1998; **280:** 1690–91.
16 Nattinger AB, Gottlieb MS, Veum BS, Yahnke D, Goodwin JS. Geographic variation in the use of breast-conserving treatment for breast cancer. *N Engl J Med* 1992; **326:** 1102–07.
17 Fisher B, Anderson S, Redmond C, Wolmark N, Wickerham DL,

Cronin WM. Re-analysis and results after 12 years of follow-up in a randomized clinical trial comparing total mastectomy with lumpectomy with or without irradiation in the treatment of breast cancer. *N Engl J Med* 1995; **333:** 1456–61.

18 Liljegren GG, Holmberg L, Andami HO, Westman G, Graffman S, Bergh J. Sector resection with or without postoperative radiotherapy for stage I breast cancer: five year results of a randomized trial. *J Natl Cancer Inst* 1994; **86:** 717–22.

19 Clark RM, Whelan T, Levine M, et al. Randomized clinical trial of breast irradiation following lumpectomy and axillary dissection for node-negative breast cancer. *J Natl Cancer Inst* 1996; **88:** 1659–64.

20 Early Breast Cancer Trialists' Collaborative Group. Effects of radiotherapy and surgery in early breast cancer: an overview of the randomized trials. *N Engl J Med* 1995; **333:** 1444–55.

21 Lee-Feldstein A, Anton-Culver H, Feldstein PJ. Treatment differences and other prognostic factors related to breast cancer survival: delivery systems and medical outcomes. *JAMA* 1994; **271:** 1163–68.

22 Goodwin JS, Samet JM, Hunt WC. Determinants of survival in older cancer patients. *J Natl Cancer Inst* 1996; **88:** 1031–38.

23 Harris JR, Morrow M, Bonadonna G. Cancer of the breast. In: DeVita Jr, Hellman S, Rosenberg SA, eds. Cancer: principles and practice of oncology. 4th edn. Philadelphia: J B Lippincott, 1993: 1264–332.

24 Ruffin WK, Stacey-Clear A, Younger J, Hoover HC Jr. Rationale for routine axillary dissection in carcinoma of the breast. *J Am Coll Cardiol* 1995; **180:** 245–51.

25 Deckers PJ. Axillary dissection in breast cancer: when, why, how much, and for how long? Another operation soon to be extinct? *J Surg Oncol* 1991; **48:** 217–19.

26 Carter CL, Allen C, Henson DE. Relation of tumour size, lymph node status, and survival in 24,740 breast cancer cases. *Cancer* 1989; **63:** 181–87.

27 White RE, Vezeridis MP, Konstadoulakis M, Cole BF, Wanebo HJ, Bland KI. Therapeutic options and results for the management of minimally invasive carcinoma of the breast: influence if axillary dissection for treatment of T1a and T1b lesions. *J Am Coll Surg* 1996; **183:** 575–82.

28 Lin PP, Allison DC, Wainstock J, et al. Impact of axillary lymph node dissection on the therapy of breast cancer patients. *J Clin Oncol* 1993; **11:** 1536–44.

29 Fisher B, Redmond C, Fisher E, et al. Ten-year results of a randomized clinical trial comparing radical mastectomy and total mastectomy with or withour radiation. *N Engl J Med* 1985; **312:** 674–81.

30 Cancer Research Campaign Working Party. Cancer Research Campaign (King's/Cambridge) trial for early breast cancer. *Lancet* 1980; **2:** 55–60.

31 Cabanes PA, Salmon RJ, Vilcoq JR, et al. Value of axillary dissection in addition to lumpectomy and radiotherapy in early breast cancer. *Lancet* 1992; **339:** 1245–48.

32 Krag D, Weaver D, Ashika T, et al. The sentinel node in breast cancer: a multicentre validation study. *N Engl J Med* 1998; **339:** 941–46.

33 McMasters KM, Giuliano AE, Ross MI, et al. Sentinel-lymph-node biopsy for breast cancer—not yet the standard of care. *N Engl J Med* 1998; **339:** 990–95.

34 Du X, Freeman JL, Goodwin JS. Information on radiation treatment in patients with breast cancer: the advantages of the linked Medicare and SEER data. *J Clin Epidemiol* 1999; **52:** 463–70.

35 Du X, Freeman JL, Freeman DH, Syblik DA, Goodwin JS. Temporal and regional variation in the breast-conserving surgery and radiotherapy for older women with early stage breast cancer from 1983 to 1995. *J Gerontol A Biol Sci Med Sci* 1999; **54A:** M474–78.

36 Nattinger AB, McAuliffe TL, Schapira MM. Generalizability of the Surveillance, Epidemiology, and End Results Registry Population: factors relevant to epidemiology and health care research. *J Clin Epidemiol* 1997; **50:** 939–45.

Early report

Contribution of central sensitisation to the development of non-cardiac chest pain

Sanchoy Sarkar, Qasim Aziz, Clifford J Woolf, Anthony R Hobson, David G Thompson

Summary

Background Non-cardiac chest pain mimics angina pectoris but generally originates from the oesophagus. Visceral hypersensitivity may contribute, but its neurophysiological basis is unclear. We investigated whether central sensitisation, an activity-dependent amplification of sensory transfer in the central nervous system, underlies visceral pain hypersensitivity and non-cardiac chest pain.

Methods We studied 19 healthy volunteers and seven patients with non-cardiac chest pain. Acid was infused into the lower oesophagus. Sensory responses to electrical stimulation were monitored within the acid-exposed lower oesophagus, the non-exposed upper oesophagus, and the cutaneous area of pain referral, before and after the infusion.

Findings In healthy volunteers, acid infusion into the lower oesophagus lowered the pain threshold in the upper oesophagus (mean decrease 18·2% [95% CI 10·4 to 26·0]; p=0·01) and on the chest wall (24·5% [10·2 to 38·7]; p=0·01). Patients with non-cardiac chest pain had a lower resting oesophageal pain threshold than healthy controls (45 [30 to 58] *vs* 64 [49 to 81] mA; p=0·04). In response to acid infusion, their pain threshold in the upper oesophagus fell further and for longer (mean fall in area under threshold/time curve 26·7 [11·0 to 42·3] *vs* 5·8 [2·8 to 8·8] units; p=0·04).

Interpretation The finding of secondary viscerovisceral and viscerosomatic pain hypersensitivity suggests that central sensitisation may contribute to visceral pain disorders. The prolonged visceral pain hypersensitivity in patients with non-cardiac chest pain suggests a central enhancement of sensory transfer. New therapeutic opportunities are therefore possible.

Lancet 2000; **356:** 1154–59
See Commentary page 1127

Section of Gastroenterology, University of Manchester, Hope Hospital, Salford, UK (S Sarkar MRCP, Q Aziz MRCP, A R Hobson MPhil, D G Thompson FRCP); **and Department of Anesthesia and Critical Care, Massachusetts General Hospital and Harvard Medical School, Boston, MA 02129, USA** (C J Woolf MRCP)

Correspondence to: Dr Clifford J Woolf, Neural Plasticity Research Group, Department of Anesthesia and Critical Care, Massachusetts General Hospital, 149 13th Street, Room 4309, Charlestown, MA 02129, USA
(e-mail: Woolf.Clifford@mgh.harvard.edu)

Introduction

Angina pectoris generally indicates myocardial ischaemia and is characterised by pain within the centre of the chest, which radiates to the neck and upper limbs and can be associated with tenderness of the anterior chest wall.[1] However, in up to a third of patients, no cardiac cause is found, and these patients are labelled as having non-cardiac chest pain.[2] In most of these patients the pain is attributed to the oesophagus on clinical grounds,[3,4] but conventional investigations do not identify the cause of the pain.

Research studies of non-cardiac chest pain have suggested that visceral pain hypersensitivity may be important in its pathogenesis, largely because stimulation of the oesophagus induces pain at intensities that are innocuous in healthy people.[5] The neurophysiological basis for this hypersensitivity is unclear; proposed mechanisms include abnormally heightened afferent nerve responses to normal sensory inputs and abnormal cognitive processing of such inputs.[2]

Somatic pain hypersensitivity after tissue injury typically has two important properties. First, it manifests both as allodynia (a previously innocuous stimulus induces pain) and hyperalgesia (the pain response to a noxious stimulus is exaggerated). Second, it is diffuse, present not only at the site of injury (primary), but also in surrounding healthy tissue (secondary).[6,7] Primary allodynia or hyperalgesia is the result of an inflammatory-mediator-induced increase in the transduction sensitivity of the peripheral terminals of high-threshold nociceptive fibres.[6,7] Secondary allodynia or hyperalgesia results solely from an increase in excitability of spinal-cord neurons (central sensitisation) induced by activation of nociceptive C-fibres in the area of injury.[6–8] Central sensitisation is mediated by phosphorylation of N-methyl-D-aspartate (NMDA) receptors expressed by dorsal-horn neurons,[6–9] which leads to an increase in their excitability and receptive field size. This process results in the recruitment and amplification of both non-nociceptive and nociceptive inputs from adjacent healthy tissue, thereby generating secondary allodynia and hyperalgesia, respectively.

Despite supporting data from studies in animals,[10–12] a role for central sensitisation in visceral pain hypersensitivity has not been established in human beings. We have explored whether secondary allodynia can be induced within the human oesophagus and whether central sensitisation has a role in the pathogenesis of visceral hypersensitivity in non-cardiac chest pain.

Methods

Participants

We recruited 19 healthy volunteers (18 male, one female; aged 21–39 years [mean 28]) affiliated with the gastrointestinal unit at Hope Hospital, Salford, UK. None had a history of chest pain or oesophageal symptoms and none were taking any prescribed medication. All had normal oesophageal motor function on standard

Draft 10/26/00

Relationship of Initial Breast Cancer Treatment and Distance from a Hospital with Radiotherapy Facilities

Ann Butler Nattinger, MD, MPH

Ronald T. Kneusel, MS

Raymond G. Hoffmann, PhD

Mary Ann Gilligan, MD, MPH

From the Departments of Medicine (A.B.N., R.T.K, M.A.G.), and Biostatistics (R.G.H.), Medical College of Wisconsin.

Word Count: 2,130 words in the text

166 words in the abstract

4 tables

Grant support from Department of the Army, Grant No. DAMD17-96-1-6262 and American

Cancer Society Cancer Development Award CCCDA-99-291-01 to Dr. Gilligan.

Address reprint requests to: Ann B. Nattinger, MD, MPH, Division of

General Internal Medicine, FEC Medical Office Building, Suite 4200, 9200 W. Wisconsin

Avenue, Milwaukee, WI 53226. Phone: 414-456-6860 Fax: 414-456-6212 Email:

anatting@mcw.edu

Distance from RT Site and Use of BCS

Abstract

Objectives: To determine the relationship of distance from a hospital with radiotherapy to receipt of breast-conserving surgery (BCS), and receipt of radiotherapy after BCS.

Methods: For 17,729 breast cancer patients from the Surveillance, Epidemiology, and End Results Tumor Registry, diagnosed in 1991-92, we determined distance from patient residence to the nearest hospital with radiotherapy facilities. We analyzed the relationship of this distance to receipt of BCS therapy, and to receipt of radiotherapy among BCS patients.

Results: Women residing 15 or more miles from a hospital with radiotherapy were significantly less likely to undergo BCS than other women. Among women undergoing BCS, those residing 40 or more miles from a hospital with radiotherapy had a lower chance of undergoing radiotherapy (OR=0.55, 95% CI=0.37-0.82). The distance factor did not, however, explain the geographic variation previously observed in the use of these treatments.

Conclusions: Long distance from patient residence to a hospital with radiotherapy is a barrier to use of BCS, and to receipt of radiotherapy after BCS.

Introduction

Substantial geographic variation in the use of breast-conserving surgery (BCS) for early stage breast cancer has been documented (1, 2). In general, BCS has been used more in the New England and Middle Atlantic states, and less in the South Atlantic and Central states (1). BCS has also been used to a greater degree in highly urban areas than less urban or rural areas (1, 3), for patients treated in hospitals with radiotherapy facilities (1, 3), and for patients residing in counties with more radiotherapy facilities (4).

In one study, the population density explained only a small part of the geographic variation in use of BCS (1). Nonetheless, the fact that BCS is used less in rural areas and less in the generally less densely populated central and southern states raises the question of whether these geographic differences may be attributable to distance the patient must travel to a radiotherapy site. According to the National Institutes of Health Consensus statement on early stage breast cancer, women undergoing BCS should receive postoperative radiotherapy to decrease the likelihood of local disease recurrence (5). Radiotherapy is typically provided in treatments that are given 5 days per week for 5-6 weeks (6, 7). Therefore, patient residence at some distance from a radiotherapy site might be a substantial barrier to the use of BCS as initial treatment.

In addition to these considerations, it has been observed that a substantial minority of women undergoing BCS do not actually receive postoperative radiotherapy (2, 4, 8, 23). Ideally, one would expect that the issue of access to a radiotherapy site would be addressed prior to the selection of BCS as initial therapy. However, it is conceivable that distance to a radiotherapy

site might also function as a barrier to receipt of radiotherapy among those women who have undergone BCS (4, 8, 9).

The purpose of this study is to better understand distance from a radiotherapy facility as a determinant of receipt of BCS as opposed to mastectomy for early breast cancer, and also as a determinant of receipt of radiotherapy among women who undergo BCS.

Methods

Patients were selected from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) registry public-use database. Information was acquired from nine distinct population-based tumor registries representing about 10% of U.S. cancer patients, and included information on patient demographics and cancer treatment. The SEER sites included were the states of Connecticut, Iowa, New Mexico, and Utah and the metropolitan areas of Atlanta, Detroit, Seattle-Puget Sound and San Francisco-Oakland. Hawaii was excluded because of the unusual geographic characteristics of this state.

A cohort was selected of 21,135 women who were aged 30 or older at time of first diagnosis of a stage I or II unilateral breast cancer in 1991-1992, and who underwent breast conserving surgery or mastectomy. We determined the census tract of residence of each patient from the SEER records, and determined the latitude and longitude of the census tract from the U.S. Census Bureau's Zip Code Equivalency file (10). We excluded 3,387 women who had incomplete census tract information: no census tract in SEER (1,687 women) or unable to locate census tract latitude and longitude from the Zip Code Equivalency file (1,700 women), leaving 17,748

women. For each patient, age at diagnosis and race were determined from SEER. As an indicator of socioeconomic status, the percent of adults living in the patient's census tract who had a college education was determined from 1990 U.S. Census (11). Information on socioeconomic status was unavailable for 19 women, leaving a final study cohort of 17,729 women.

To determine the location (latitude and longitude) of U.S. hospitals offering radiotherapy services, the following procedure was used. General medical/surgical hospitals offering radiotherapy services were determined using the 1990 American Hospital Association (AHA) Annual Survey of Hospitals (12). Of the 1,257 such hospitals, the latitude and longitude of 87% were determined from the 1997 AHA Annual Survey (13). (The 1997 AHA Annual Survey was the first year to include hospital latitude and longitude, the coordinates of which were determined directly from the street address.) For those hospitals not included in the 1997 Annual Survey, we determined the latitude and longitude of the hospital's zip code from the U.S. Census Bureau data (14).

Statistical Analysis

For each patient in the cohort, the hospital with the shortest distance from the census tract of residence of that patient was determined, using a standard formula for computing the distance between two coordinates of latitude and longitude (15).

The relationship of distance to a hospital with radiotherapy and receipt of BCS therapy was determined, with and without adjustment for the patient characteristics of age, stage, race, and educational status, which have previously been shown to be determinants of use of BCS (1, 2,

16). Logistic regression was employed, with the dependent variable whether the patient underwent BCS therapy or mastectomy. Age was categorized as 30-49 years, 50-64 years, 65-79 years, and 80 or more years at diagnosis. Race was categorized as white, non-white, or unknown. The proportion of adults in the census tract of residence of the patient with a college education was analyzed as a continuous variable.

In separate analyses, the relationship of distance to a hospital with radiotherapy was determined for women who did or did not undergo radiotherapy after undergoing a BCS procedure. A multivariable analysis again employed logistic regression to adjust for the patient characteristics.

Results

Of the 17,729 women in the study cohort, over half had stage I disease, the majority were white, and almost 60% underwent mastectomy therapy (Table 1). Of the 7,384 patients who underwent BCS, 74.8% were known to have undergone radiotherapy, and 2.7% more had an unknown status with respect to radiotherapy. The median patient lived 4.1 miles from a hospital with radiotherapy, the mean distance from a hospital with radiotherapy was 7.8 ± 12.1 miles, and 89.2% of the patients lived within 15 miles of such a hospital.

Women residing an increasing distance from a hospital with radiotherapy had a declining likelihood of undergoing BCS (Fig., Table 2). The lower probability of undergoing BCS was statistically significant for women residing 15 miles or more from the nearest hospital with radiotherapy, as the confidence intervals at these distances excluded one. There was no substantive difference in the results with or without adjustment for the patient characteristics of

age, stage of disease, race, and educational status. Therefore, only adjusted results are presented in the table.

We had postulated that any relationship of distance to radiotherapy site and therapy undergone might be more prominent among older women. However, when the analysis was limited to the 8095 women aged 65 and older, the results were virtually the same as for the entire cohort (Table 2).

Among the 7,187 women who underwent BCS and for whom receipt of radiotherapy was known, we explored the relationship of distance from a hospital with radiotherapy and receipt of radiotherapy. A significant decrease in the probability of receipt of radiotherapy was observed for women living 40 or more miles from a radiotherapy site (Table 3). This finding also was not changed by adjustment for the patient characteristics. Although this finding was significant, only 1.7% of the patients who received BCS lived this far from a hospital providing radiotherapy. Similar results were obtained when the analysis was limited to women aged 65 and older.

We were further interested in whether the relationship between distance from radiotherapy facility and receipt of BCS might explain the differential use of BCS previously observed by geographic region and size of MSA. To determine this, we assessed the fit of logistic regression models, incrementally including the relevant factors. As seen in table 4, the likelihood ratio test for a logistic model using the patient covariates (age, race, stage, education) plus distance from radiotherapy is significant, compared to a model including only the patient covariates as predictors of receipt of BCS. When the size of the MSA in which the patient resides is added to

that model, the likelihood ratio test is again significant, implying that MSA size contributes explanatory power incremental to that of the radiotherapy distance and the patient characteristics. In an analogous comparison, when SEER site is added to the model with radiotherapy distance, the likelihood ratio test is highly significant, again suggesting that geographic region adds predictive value incremental to that of distance and the patient characteristics.

Using a similar set of comparisons, we found that size of MSA and SEER site also have incremental explanatory power in a model including patient characteristics and distance as predictors of receipt of radiotherapy after undergoing BCS (table 4).

Discussion

We find a significant decrease in the likelihood of undergoing BCS as opposed to mastectomy among women who reside 15 or more miles from a hospital with radiotherapy facilities. This finding persists after controlling for patient characteristics known to predict use of BCS and is observed for women both older and younger than age 65. Among women who undergo BCS, a lower probability of undergoing radiotherapy is observed consistently only among women who reside 40 or more miles from a hospital with radiotherapy facilities.

Geographic variation has been demonstrated previously in the use of BCS, and in the use of radiotherapy after BCS (1-3, 18). Transportation could be a barrier to receipt of BCS or radiotherapy (19), as may be the case for other cancer treatments (20,21). This study finds that, although distance is a determinant of those treatments, distance does not account for all the geographic variation in their use. Similarly, distance does not account for the previously

demonstrated (1,3) fact that women residing in more urban areas have a greater use of BCS than other women.

The lesser use of BCS among breast cancer patients living 15 or more miles from a radiotherapy dite does not mean that these women undergo inappropriate care. Nonetheless, these women may not perceive access to BCS as a realistic treatment option. The finding of a lower use of radiotherapy among BCS recipients living 40 or more miles from a hospital with radiotherapy, however, does raise an issue of appropriateness of care (23). Radiotherapy has been clearly recommended for women who undergo breast conservation as primary therapy (5), and women who undergo BCS without radiotherapy have local recurrence rates of about 35% over 5 years (24-27).

Although the distance of more than 15 miles from a radiotherapy site has a moderate effect on the receipt of BCS, only 11% of the women in this cohort lived 15 miles or farther away. Similarly, only 3.1 % of the entire study cohort and 1.7% of the BCS patients lived 40 miles or more away from a hospital with radiotherapy. However, this cohort probably under-represents the actual percentage of U.S. women living more than 15 (or more than 40) miles from a hospital with radiotherapy for two reasons. We had to exclude almost 8% of the potentially eligible patients due to lack of a census tract, and such women are probably more likely to reside in rural areas. Also, persons residing in the SEER coverage areas are more urban than the remainder of the U.S. population (17). For example, in 1990, 14.1% of the SEER population resided in rural areas, compared with 22.7% of the non-SEER U.S. population (17). Therefore, the percentage of

U.S. women affected by the findings of this study is probably higher than the percentage in this particular cohort.

This study is limited by the fact that we did not know the hospital at which the patient actually underwent her breast cancer operation. It is possible that a woman who underges surgery at one hospital might not consider the possibility of obtaining radiotherapy at a different hospital. Also, the distances were calculated as the shortest distance between two points, which may be shorter than the actual traveling distance. However, our analysis was consistently based on the minimum distance the patient would have needed to travel to obtain radiotherapy.

It is also possible that the SEER data misclassified some women with respect to receipt of radiotherapy (22). Assuming that such misclassification is independent of distance from a hospital with radiotherapy facilities, it would tend to reduce the power of this study in determining differences in use of radiotherapy by distance. Therefore, the true distance at which receipt of radiotherapy is influenced by distance from a radiotherapy site might be less than the 40 miles we report.

In conclusion, distance from a hospital with radiotherapy facilities is a barrier to the receipt of BCS for early stage breast cancer, and also to the receipt of radiotherapy after BCS. This factor does not account for the previously reported variations in breast cancer treatment by geographic region, nor for the greater propensity of women living in more urban areas to undergo BCS treatment.

References

1. Nattinger AB, Gottlieb MS, Veum J, Yahnke D, Goodwin JS. Geographic Variation in the Use of Breast-Conserving Treatment for Breast Cancer. N Engl J Med 1992;326:1102-1107.
2. Farrow DC, Hunt WC, Samet JM. Geographic Variation in the Treatment of Localized Breast Cancer. N Engl J Med 1992;326:1097-1101.
3. Nattinger AB, Gottlieb MS, Hoffman RG, Walker AP, Goodwin JS. Minimal Increase in Use of Breast-Conserving Surgery from 1986 to 1990. Med Care 1996;34:479-489.
4. Ballard-Barbash R, Potosky AL, Harlan LC, Nayfield SG, Kessler LG. Factors Associated with Surgical and Radiation Therapy for Early Stage Breast Cancer in Older Women. JNCI 1996;88:716-726.
5. Treatment of Early-Stage Breast Cancer. NIH Consensus Statement 1990 June 18-21; 8(6) 1-19.
6. Winchester DP, Cox JD. Standards for Breast-Conservation Treatment. CA-A Can J for Clinicians 1992;42:134-162.
7. Winchester DP, Cox JD. Standards for Diagnosis and Management of Invasive Breast Carcinoma. CA-A Can J for Clinicians 1998;48:83-107.
8. Mann BA, Samet JM, Hunt WC, Key CR, Goodwin JM, Goodwin JS. Changing Treatment of Breast Cancer in New Mexico From 1969 Through 1985. JAMA 1988;259:3413-3416.
9. Lazovich D, White F, Thomas DB, Moe RD. Underutilization of Breast-Conserving Surgery and Radiation Therapy Among Women with Stage I or II Breast Cancer. JAMA 1991;266:3433-3438.
10. Zip Code Equivalency File, http://www.census.gov/mp/www/tape (10/18/00)
11. U.S. Census Bureau, 1990 Census Lookup, http://venus.census.gov/cdrom/lookup (10/18/00)

12. American Hospital Association. Hospital Statistics: 1990 Ed. Chicago, IL: Amer Hosp Assoc, 1991.

13. American Hospital Association. Hospital Statistics: 1997 Ed. Chicago, IL: Amer Hosp Assoc, 1998.

14. M.S. Gazetteer, http://ftp.census.gov/geo/www/gazetteer/places.html (10/18/00)

15. Lat/Longit Distance Formula. Weisstein EW. Great Circle. CRC Concise Encyclopedia of Mathematics, Boca Raton, FL; CRC Press, 1998.

16. Michalski TA, Nattinger AB. The influence of black race and socioeconomic status on the use of breast-conserving surgery in Medicare beneficiaries. Cancer 1997;79:314-319.

17. Nattinger AB, McAuliffe TL, Schapira MM. Generalizability of the surveillance, epidemiology, and end results registry population: Factors relevant to epidemiology and health care research. J Clin Epidemiol 1997;50:939-945.

18. Osteen RT, Steele G, Menck H, Winchester DP. Regional differences in surgical management of breast cancer. CA Cancer J Chin 1992: 42: 39-

19. Ayanian JZ, Ghadagnoli E. Variations in breast cancer treatment by patient and provider characteristics. Breast Cancer Research and Treatment 1996; 40:65-74.

20. Goodwin JS, Hunt WC, Sarnet JM. Determinants of cancer therapy in elderly patients. Cancer 1993; 72:594-601.

21. Guidry JJ, Aday LA, Zhang D, Winn RJ. Transportation as a barrier to cancer treatment. Cancer Practice 1997; 5: 361-366.

22. Du X, Freeman JL, Goodwin JS. Information on Radiation Treatment in Patients with Breast Cancer: The Advantages of the Linked Medicare and SEER Data. J Clin Epidemiol 1999;52:463-470.

23. Nattinger AB, Hoffmann RG, Kneusel RT, Schapira MM. Relation between appropriateness of primary therapy for early-stage breast carcinoma and increased use of breast-conserving surgery. Lancet 2000;356:1148-53.

24. Fisher B, Anderson S, Redmond C, Wolmark N, Wickerham DL, Cronin WM. Re-analysis and results after 12 years of follow-up in a randomized clinical trial comparing total mastectomy with lumpectomy with or without irradiation in the treatment of breast cancer. N Engl J Med 1995;333:1456-61.

25. Lijegren GG, Holmberg L, Andami HO, Westsman G, Graffman S, Bergh J. Sector resection with or without postoperative radiotherapy for stage I breast cancer: five year results of a randomized trial. J Natl Cancer Inst 1994;86:717-22.

26. Clark RM, Whelan T, Levine M, et al. Randomized clinical trial of breast irradiation following lumpectomy and axillary dissection for node-negative breast cancer. J Natl Cancer Inst 1996;88:1659-64.

27. Early Breast Cancer Trialists' Collaborative Group. Effects of radiotherapy and surgery in early breast cancer: an overview of the randomized trials. N Engl J Med 1995;333:1444-55.

Table 1

Characteristics of Patients in the Cohort

		Number	Percentage
Age at diagnosis (years):			
	30 - 49	4,354	24.6
	50 - 64	5,280	29.8
	65 - 79	6,198	35.0
	80+	1,897	10.7
Stage (AJCC):			
	I	9,740	54.9
	II	7,989	45.1
Race:			
	White	15,603	88.0
	Black	1,439	8.1
	Other/Unknown	687	3.9
		Number	Percentage
SEER site:			
	San Francisco	3,413	19.2
	Connecticut	2,813	15.9
	Detroit	3,818	21.5
	Iowa	2,225	12.5
	New Mexico	770	4.3
	Seattle	2,273	12.8
	Utah	1,058	6.0
	Atlanta	1,359	7.7
Surgery:			
	Mastectomy	10,345	58.3
	BCS with RT	5,377	30.3
	BCS without RT	1,810	10.2
	BCS with unknown RT	197	1.1
Percent of census tract with college education			
	Mean = 26.5%		
	Standard deviation = 16.8%		

Table 2

Distance of Patient Residence to Nearest Hospital with Radiotherapy, as a Predictor of Use of BCS for Early Stage Breast Cancer

	Odds of Receipt of BCS*	
Distance from Hospital with Radiotherapy	Overall OR (95%CI)	Age ≥ 65 years OR (95%CI)
<5 miles	-	-
5 to <10 miles	1.08 (1.00-1.06)	1.07 (0.95-1.20)
10 to <15 miles	1.07 (0.95-1.19)	0.98 (0.82-1.18)
15 to <20 miles	0.76 (0.62-0.92)	0.72 (0.52-0.99)
20 to <30 miles	0.61 (0.50-0.75)	0.49 (0.37-0.66)
30 to <40 miles	0.44 (0.34-0.58)	0.32 (0.22-0.45)
40+ miles	0.43 (0.35-0.53)	0.42 (0.31-0.56)

*Adjusted for age, stage of disease, race, educational status.

Table 3

Distance of Patient Residence to Nearest Hospital with Radiotherapy Facilities, as a Predictor of Use of Radiotherapy, Among Patients Undergoing BCS

	Odds of Receipt of Radiotherapy*	
Distance from Hospital with Radiotherapy	Overall OR(95%C1)	Age ≥ 65 OR(95%)
0 to <10 miles	-	-
10 to <20 miles	0.79 (0.65-0.94)	0.76 (0.57-1.01)
20 to <30 miles	1.03 (0.68-1.55)	0.81 (0.46-1.40)
30 to <40 miles	0.91 (0.55-1.51)	0.97 (0.47-2.01)
40+ miles	0.55 (0.37-0.82)	0.56 (0.32-0.97)

*Adjusted for age, stage, race, and educational status.

Table 4

Incremental Explanatory Effect of Distance from Radiotherapy Site, Size Of MSA*, and SEER** Site on Breast Cancer Treatment

Model Components	LR Test	P-value	R^2
Use of BCS vs Mastectomy			
1. Covariates	—	—	—
2. Covariates + Distance	151.9 with 6 df. (versus model 1)	< 0.001	0.275
3. Covariates + Distance + MSA	79.7 with 2 df. (versus model 2)	<0.001	0.282
4. Covariates + Distance + SEER Site	389.3 with 7 df. (versus model 2)	<0.001	0.311
Use of RT in BCS Patients			
5. Covariates	—	—	—
6. Covariates + Distance	13.8 with 4 df. (versus model 5)	0.008	0.368
7. Covariates + Distance + MSA	56.4 with 2 df. (versus model 6)	<0.001	0.377
8. Covariates + Distance + SEER Site	237.3 with 8 df. (versus model 6)	<0.001	0.405

* MSA = size of metropolitan statistical area

** SEER = Surveillance, Epidemiology, and End Results Registry

df. refers to degrees of freedom

Survival of Women After Breast Conserving Surgery for Early Stage Breast Cancer

Xianglin Du, MD, PhD,* Jean L. Freeman, PhD,* Ann B. Nattinger, MD, MPH,†

James S. Goodwin, MD*

* From the Department of Internal Medicine, Department of Preventive Medicine and Community Health, and Sealy Center on Aging, University of Texas Medical Branch, Galveston, Texas;

† From the Division of General Internal Medicine, Medical College of Wisconsin, Milwaukee, Wisconsin.

Address correspondence to: Xianglin Du, MD, PhD, Department of Internal Medicine, 3.134 Jennie Sealy Hospital, University of Texas Medical Branch, Galveston, TX 77555-0460.

Tel: (409) 747 2333; Fax: (409) 772 8931; E-mail: xdu@utmb.edu

Word count: 2,832 words of text, excluding **abstract (250 words)**, acknowledgements, references, 3 tables and 1 figure legend.

Abbreviations:

AJCC stages: American Joint Committee on Cancer stages

BCS: Breast Conserving Surgery

SEER: Surveillance, Epidemiology and End Results

Key words: breast cancer; axillary node dissection; breast-conserving surgery; survival.

Background. Increasing numbers of older women with breast cancer are receiving breast-conserving surgery (BCS). **However, substantial numbers of them are not receiving either axillary dissection or adjuvant irradiation.**

Objective. To determine whether failure to perform axillary dissection **or irradiation** is associated with decreased survival in women with early-stage breast cancer.

Method. We studied 26,290 women with early-stage breast cancer aged ≥25 in 1983-1993 who received BCS, using data from Medicare and the Surveillance, Epidemiology and End Results Program.

Results. Twenty seven percent of women aged ≥25 receiving BCS did not receive axillary dissection, most of whom (74%) were age ≥65. Women receiving BCS with axillary dissection had lower 7-year breast cancer-specific mortality than did those without dissection (hazard ratio=0.53, 95% confidence interval: 0.44-0.63). We found an interaction between receipt of axillary dissection and radiotherapy on survival of older women after BCS. Women who received either axillary dissection or radiotherapy experienced similar survivals to those who received both axillary dissection and radiation, while women who received neither treatment experienced poorer survival (hazard ratio=1.76, 1.23-2.52), after controlling for demographics, tumor size and comorbidity.

Conclusions. The combination of no axillary dissection plus no radiation after BCS is associated with an unacceptably high level of deaths from breast cancer. The lack of improvement in the past two decades in survival of older women with breast cancer may be explained in part by the increasing use of treatments that do not address potential tumor in axillary nodes.

Introduction

Axillary node dissection is a component of modified radical mastectomy, and also is commonly used in breast conserving surgery. There are two major rationales for axillary dissection.[1-3] First, it physically removes potentially cancerous tissue in the axilla. Second, it allows for adequate staging information as a guide to more appropriate therapy. It could be argued that these two rationales are less compelling today than in the 1980's and before. For example, radiotherapy to the axillary nodes would accomplish a similar goal to physical removal of cancerous tissue.[4] Also, increased use of adjuvant chemotherapy in early stage breast cancer means that the distinction between local and regional cancer may have less impact on choice of therapy now than it did before.

The reasons outlined above have led some authorities to question the wisdom of routine axillary dissection,[5-8] and this is reflected in an increasing percentage of women with early stage breast cancer who do not receive axillary dissection as part of initial treatment.[1,9]

On the other hand, there are serious concerns raised by the omission of axillary dissection. It would appear that substantial numbers of older women who do not receive axillary dissection also are not receiving radiation therapy or chemotherapy.[1,10-12] Approximately 20-50% of women with early stage breast cancer will have positive axillary nodes found on axillary dissection.[1,13,14] In most women with axillary node metastases there is no indication of metastases on clinical palpation of the axilla.[13-18] Even women with very small primary tumors of 0.5 to 1.0 cm in size have a greater than 10% incidence of axillary node metastases.[1,19] It

would appear that many of these women are receiving no therapy directed against the axillary node tumor.[1,10]

Therefore, we hypothesize that the failure to perform axillary dissection is associated with decreased survival in women diagnosed with early stage breast cancer. To test this hypothesis we examined the survival difference between older breast cancer patients receiving axillary dissection and those without axillary dissection, and examined the role of radiation therapy, chemotherapy and comorbidity. We used a data base in which information from the Surveillance, Epidemiology and End Results (SEER) registry was linked to Medicare Part A and B files.[20-22] This allows us to better consider factors such as adjuvant radiation therapy and chemotherapy, as well as control for comorbidity, in survival analyses.

Methods

Data Sources

We used two data sources: (1) the Surveillance, Epidemiology and End Results (SEER) 1973-96 Public Use Data Set, and (2) the merged SEER-Medicare database. The SEER Public Use Data Set was used to examine the 7-year survival rate for cases diagnosed in 1988 and 1989. The SEER-Medicare linked database was used to examine the use of radiation therapy and chemotherapy and to determine comorbidity levels for cases diagnosed between 1991 and 1993. These years were studied because Medicare claims were available for all incident cases diagnosed beginning in 1991.

The SEER program supports population-based tumor registries in four metropolitan areas (San Francisco/Oakland, Detroit, Atlanta, and Seattle) and five states (Connecticut, Iowa, New Mexico, Utah, and Hawaii), covering approximately 10% of the U.S. population.[23] Since 1992 SEER registries included 11 areas, accounting for about 14% of the U.S. population.[23] Information includes tumor location, size and histologic type; demographic characteristics such as age, gender, race and marital status; and types of treatment provided within four months after the date of diagnosis.[24] The SEER data set does not contain information on comorbidity, and information on chemotherapy and radiation therapy is considered incomplete.[20,21,25]

The Medicare claims data used in the study included inpatient hospital claims; claims for outpatient facility services, including ambulatory surgery; and claims for physicians' and other medical services. Cases reported by the SEER registries from 1991 to 1996 have been matched against the Medicare master enrollment file. The method of linking these data has been described elsewhere.[20]

Study Population

Two study populations were analyzed separately. In the SEER data set, there were 26,290 female patients aged 25 and older who were diagnosed with early stage breast cancer, i.e. the American Joint Committee on Cancer (AJCC) stages I or II in 1988-1993, and who received breast-conserving surgery.

In the SEER-Medicare linked data, after excluding those without both Medicare Part A and Part B in the year of diagnosis, the study population were 14,089 women diagnosed with

early stage (AJCC stage I or stage II) breast cancer at age 65 and older in 1991-1993. After excluding those who received mastectomy, or received no cancer directed surgery, or had missing information on the months of diagnosis, 5,328 who received breast-conserving surgery were included in the analysis.

Treatment and survival

Surgery and axillary dissection. In SEER, breast-conserving surgery (BCS) was defined as segmental mastectomy, lumpectomy, quadrantectomy, tylectomy, wedge resection, nipple resection, excisional biopsy, or partial mastectomy unspecified, with or without dissection of axillary lymph nodes.[24]

Radiation therapy. We have previously shown that combining data from SEER and Medicare provided more complete information on radiation therapy.[21] As previously described, receipt of radiation therapy was determined from SEER, supplemented by review of Medicare claims for radiation therapy within 4 months after diagnosis.

Chemotherapy. Chemotherapy was ascertained from the Medicare data through procedure and revenue center codes on at least one claim for chemotherapy made within 12 months after diagnosis of breast cancer. These codes included the ICD-9-CM procedure code of 9925 for a hospital inpatient or outpatient facility claim of chemotherapy (injection or infusion of cancer chemotherapeutic substance),[26] the Common Procedure Terminology codes of 96400-96549, J9000-J9999, and Q0083-Q0085 for a physician or outpatient claim of chemotherapy administration,[27,28] and revenue center codes of 0331 (chemotherapy injected), 0332

(chemotherapy oral) and 0335 (chemotherapy intravenous) for an outpatient claim of chemotherapy.[29] The ICD-9-CM V codes[26] of V58.1, V66.2, or V67.2 for follow-up examination or care after chemotherapy was also used, that generated 3 additional cases in the category of receiving chemotherapy within 12 months of diagnosis.

Comorbidity index. Comorbidity was ascertained from the Medicare data through ICD-9-CM diagnoses or procedures on claims made 2 years prior to the diagnosis of breast cancer. We used the comorbidity index created by Charlson[30] and later validated by Romano and colleagues using the ICD-9-CM diagnosis and procedure codes.[31] Comorbidity scores were calculated for each patient. Both the Medicare inpatient and outpatient claims were searched for comorbid conditions, but not including breast cancer diagnosis codes (ICD-9-CM codes of 174x). Patients who had no inpatient or outpatient Medicare claims during this period were coded as a separate category.

Mortality and Survival Time. Breast cancer-specific death was defined similar to the method of the Early Breast Cancer Trialists' Collaborative Group,[4] if patients died of breast cancer as a underlying cause of death, or if patients with breast cancer died of unknown causes which was similarly used by other investigator. Information on months of survival from the date of diagnosis was provided in SEER. The last date of the follow-up for this cohort was December 31, 1996. This would allow analyses on the 7-year survival in women diagnosed with breast cancer in 1988-1989 from SEER Public Use Data, and 3-year survival among women diagnosed in 1991-1993 from the SEER-Medicare linked data.

Analysis

After patients who were lost to follow-up or died of other diseases were censored, a 7-year Kaplan-Meier survival curve was produced using the LIFETEST procedure for women diagnosed with breast cancer in 1988-1989.[32] In a separate analysis, all deaths in the first four years were censored and a survival curve from 4 to 7 years was constructed, in order to reduce any effect of comorbidity which might be expected to differentially affect early deaths. The log rank test was used to test the significant differences between stratified curves. In addition, the Cox proportional hazard model was used in the survival analyses using the PHREG procedure available in the SAS statistical package.[32] These analyses took into account possible confounding factors such as age, race, marital status, cancer stage, tumor size, SEER area, and comorbidity level.

Results

Table 1 presents the percentages of women receiving breast-conserving surgery (BCS) with or without axillary dissection by patient and tumor characteristics. Overall, 27% of all women with early stage breast cancer who underwent BCS did not receive axillary dissection as part of initial surgical treatment. Older women, unmarried women and those with very small (<0.5 cm) or very large tumors (>=4.0 cm) were less likely to receive axillary dissection. The data on the percentages receiving axillary dissection by stage are misleading, because the major means of distinguishing regional from local stage is by axillary dissection. Thus there is a misclassification bias of underreporting regional stage tumor in women without axillary dissection. Because of this, in the survival analyses we control for tumor size rather than stage.

Figure 1 presents Kaplan-Meier survival curves of the 7–year breast cancer specific survival for women receiving BCS with or without axillary dissection. Survival was significantly greater for women with axillary dissection as compared to those without axillary dissection (P=0.0001). The hazard ratio for mortality at seven years was 0.53 (0.44-0.63) for women with axillary dissection as compared with those without, after adjusting for age, marital status, race, tumor size and SEER area. There was also a significant difference in the survival curves between years 4 and 7 (P=0.0001) after deaths in the first 3 years were censored as a crude control for comorbidity.

As discussed in the Introduction, axillary dissection may be less important if patients not receiving axillary dissection receive adjuvant radiation therapy or chemotherapy. We investigated this issue in women aged 65 and over and diagnosed with early stage breast cancer between 1991 and 1993 using the SEER-Medicare linked data, which provides information on radiation therapy, chemotherapy, and comorbid conditions.[20] Table 2 presents the percentage of women receiving radiation and chemotherapy as a function of receipt of axillary node dissection. Of women receiving BCS without axillary dissection, nearly two-thirds (62%) also did not receive radiation therapy. The great majority of these older women (97%) did not receive chemotherapy. Women not receiving axillary dissection actually had a lower chance of receiving radiation or chemotherapy than those who had axillary dissection.

Table 3 presents the interaction between axillary dissection and receipt of radiation therapy on mortality of women aged 65 and older with early stage breast cancer. Women receiving neither axillary dissection nor radiotherapy were at a significantly higher risk for death,

compared to those who received both axillary dissection and radiation therapy. Women receiving either radiation alone without axillary dissection, or axillary dissection without radiation were not at significantly higher risk for death, after adjusting for patient and tumor characteristics.

Discussion

The findings of this study can be summarized as follows. First, substantial numbers of older women receiving breast-conserving surgery do not receive axillary dissection. Second, of those women not receiving axillary dissection, most also do not receive either adjuvant radiation therapy or chemotherapy. In other words, they receive no therapy directed at occult cancer in the axillary nodes. The percentage of older women who receive no therapy to their axillary nodes has been steadily increasing over the past decade.[1,33-35] Third, patients receiving breast-conserving surgery without axillary dissection experience significantly worse survivals than those who do, after controlling for other factors known to affect survival. Finally, there is an interaction between receipt of axillary dissection and radiation therapy on survival, such that women who receive either axillary dissection or radiation therapy experience similar survivals to those who receive both axillary dissection and radiation, while women who receive neither treatment experience substantially poorer survivals.

In randomized controlled trials of women receiving breast-conserving surgery for early stage breast cancer, axillary dissection has no impact on survival, while the present study and

another recent report[9] found a strong effect of axillary dissection on survival in women treated in the community. We will discuss several possible reasons for this difference.

First, in the randomized trials showing no survival advantage associated with axillary node dissection, all other therapies (e.g., radiation, chemotherapy) were held constant. In actual community practice, a major theoretical benefit of axillary dissection would be that the results would influence choice of other treatments. At least one RCT has results that directly support that interpretation. Cabanes and colleagues[36] randomized 658 patients with breast cancers < 3 cm in diameter to receive lumpectomy alone or lumpectomy plus axillary dissection. All patients received radiotherapy to the breast and axilla, but choice of chemotherapy and tamoxifen was left to the discretion of the treating physicians. Not surprisingly, the group receiving axillary dissection had a much higher percentage of patients classified as regional stage; these patients in turn were more likely to receive adjuvant therapies; and they experienced substantially lower overall five year mortality (relative risk of death for the group not receiving axillary dissection = 2.4, $P<0.01$).

Second, follow-up of patients would be expected to be better in a randomized controlled trial than in the community. Local or regional recurrence of disease would be picked up early, and appropriate therapy was initiated, thus minimizing the impact of axillary dissection on survival. In the community, surveillance after initial treatment for breast cancer is sporadic. For example, 22% of women who underwent breast-conserving surgery without adjuvant radiotherapy did not receive any mammography in the 2 years after initial treatment.[37]

A third potential explanation for the discrepancy between randomized controlled trials and population-based observational studies on the impact of axillary dissection on survival is possible selection bias in the community; that is, women with underlying comorbidity might be less likely to receive axillary dissection and also be at higher risk for death. However, it is important to note that we were assessing only breast cancer-specific mortality, not total mortality. In addition, controlling for underlying comorbidity did not appreciably affect the increased breast cancer-specific mortality associated with axillary dissection. Finally, eliminating all deaths in the first four years after diagnosis, as an additional control for comorbidity, did not eliminate the impact of axillary dissection on breast cancer-specific survival.

We found no difference in survival among those who received axillary dissection plus radiation versus radiation therapy alone. This was unexpected, because those receiving axillary dissection would be more likely to be correctly staged and therefore more likely to receive chemotherapy and other treatments (Table 2 and reference 21). One reason for this may be that too few women received chemotherapy for there to be a noticeable effect on survival (Table 2).

We should point out the limitations of this study. First, there is no information on why women did not have an axillary dissection. **Second, information on chemotherapy from Medicare has not been well validated externally, and its completeness is unknown. However, our preliminary data on patterns of chemotherapy use would suggest that Medicare claims data are relatively complete and accurate in identifying chemotherapy use (manuscript submitted for publication). In addition, as we previously demonstrated, the**

fact that Medicare data demonstrates good validity in other aspects of breast cancer care (radiation therapy and type of surgery)[21,22] provides indirect support for the validity of information for chemotherapy in Medicare. The information on radiation therapy from the combined sources of SEER and Medicare would appear to be complete.[21] Third, there was no information on the use of sentinel node biopsy in SEER, although this procedure may have potential to be a replacement for routine axillary dissection. However, it has still not been confirmed for routine use,[38] and it was unlikely to have been widely used during the study period. Finally, information on estrogen-blocking therapy for breast cancer cannot be addressed. We assumed that women not receiving axillary node dissection, who would thus be likely for understaging, would have been less likely to receive estrogen antagonists, just as they were less likely to receive radiation and chemotherapy.

In conclusion, a substantial number of older women with early stage breast cancer in the United States receive BCS without axillary dissection, and most of those women also do not receive adjuvant radiation. This combination of no axillary dissection plus no radiation after BCS is associated with an unacceptably high level of deaths from breast cancer. Breast cancer survival has improved steadily over the past 25 years, except for older women.[39,40] The lack of improvement in the past two decades in survival of older women may be explained in part by the increasing numbers of older women who receive treatments that do not address potential tumor in the axillary nodes.[1,9]

Acknowledgments

This study was supported by grants from the Department of Defense (DAMD17-99-1-9397 and

DAMD17-96-1-6262) and the National Cancer Institute (CA871773). We thank Dong Zhang, Ph.D., for his data management and analytical support. This study used the Linked SEER-Medicare Database. The interpretation and reporting of these data are the sole responsibilities of the authors. The authors acknowledge the efforts of the Applied Research Branch, Division of Cancer Prevention and Population Science, NCI; the Office of Information Services, and the Office of Strategic Planning, HCFA; Information Management Services (IMS), Inc.; and the SEER Program tumor registries in the creation of the SEER-Medicare Database.

Presented in part at the Society for Epidemiologic Research Annual Scientific Meeting, Seattle, WA, June 15-17, 2000.

References

1. Du XL, Freeman JL, Goodwin JS. The declining use of axillary dissection in patients with early stage breast cancer. Breast Cancer Res Treat 1999;53:137-144.

2. Ruffin WK, Stacey-Clear A, Younger J, Hoover HC, Jr. Rationale for routine axillary dissection in carcinoma of the breast. J Am College Surg 1995;180:245-51.

3. Recht A, Houlihan MJ. Axillary lymph nodes and breast cancer: a review. Cancer 1995;76:1491-512.

4. Early Breast Cancer Trialists' Collaborative Group. Effects of radiotherapy and surgery in early breast cancer. An overview of the randomized trials. N Eng J Med 1995;333:1444-55.

5. Deckers PJ. Axillary dissection in breast cancer: when, why, how much, and for how long? Another operation soon to be extinct? J Surg Oncol 1991;48:217-19.

6. Silverstein MJ, Gierson ED, Waisman JR, Senofsky GM, Colburn WJX, Gamagami P. Axillary lymph node dissection for T1a breast carcinoma. Is it indicated? Cancer 1994;73:664-7.

7. Cady B. The need to reexamine axillary lymph node dissection in invasive breast cancer. Cancer 1994;73:505-8.

8. Cady B. Is axillary lymph node dissection necessary in routine management of breast cancer? Important Adv Oncology 1996;251-65.

9. Bland KI, Scott-Conner CE, Menck H, Winchester DP. Axillary dissection in breast-conserving surgery for stage I and II breast cancer: a National Cancer Data Base study of patterns of omission and implications for survival. J Am Coll Surg 1999;188:586-95.

10. White RE, Vezeridis MP, Konstadoulakis M, Cole BF, Wanebo HJ, Bland KI. Therapeutic options and results for the management of minimally invasive carcinoma of the breast: influence of axillary dissection for treatment of T1a and T1b lesions. J Am Coll Surg 1996;183:575-82.

11. Silliman RA, Guadagnoli E, Weitberg AB, Mor V. Age as a predictor of diagnostic and initial treatment intensity in newly diagnosed breast cancer patients. J Gerontol 1989;44:M46-50.

12. Silliman RA, Balducci L, Goodwin JS, Holmes FFX, Leventhal EA. Breast cancer care in old age: what we know, don't know, and do. J Natl Cancer Inst 1993;85:190-9.

13. Fisher B, Wolmark N, Bauer M, Redmond C, Gebhardt M. The accuracy of clinical nodal staging and of limited axillary dissection as a determinant of histologic nodal status in carcinoma of the breast. Surg Gynecol Obstet 1981;152:765-72.

14. Carter CL, Allen C, Henson DE. Relation of tumor size, lymph node status, and survival in 24,740 breast cancer cases. Cancer 1989;63:181-7.

15. Danforth DN, Jr., Findlay PA, McDonald HD, Lippman MEX, Reichert CM, d'Angelo T, et al. Complete axillary lymph node dissection for stage I-II carcinoma of the breast. J Clin Oncol 1986;4:655-62.

16. Sacre RA. Clinical evaluation of axillar lymph nodes compared to surgical and pathological findings. Euro J Surg Oncol 1986;12:169-73.

17. Nasser IA, Lee AK, Bosari S, Saganich R, Heatley GX, Silverman ML. Occult axillary lymph node metastases in "node-negative" breast carcinoma. Human Path 1993;24:950-7.

18. Margolis DS, McMillen MA, Hashmi H, Wasson DW, MacArthur JD. Aggressive axillary evaluation and adjuvant therapy for nonpalpable carcinoma of the breast. Surg Gynecol Obstet 1992;174:109-13.

19. Halverson KJ, Taylor ME, Perez CA, et al. Management of the axilla in patients with breast cancers one centimeter or smaller. Am J Clin Oncol 1994;17:461-6.

20. Potosky AL, Riley GF, Lubitz JD, Mentnech RM, Kessler, LG. Potential for cancer related health services research using a linked Medicare-tumor registry database. Med Care 1993;31:732-48.

21. Du XL, Freeman JL, Goodwin JS. Information on radiation treatment in patients with breast cancer: the advantages of the linked Medicare and SEER data. J Clin Epidemiol 1999;52:463-70.

22. Du XL, Freeman JL, Warren JL, Nattinger AB, Zhang D, Goodwin JS. Accuracy and completeness of Medicare claims data for surgical treatment of breast cancer. Med Care 2000;38:719-727.

23. Ries LAG, Kosary CL, Hankey BF, Miller BA, Harras A, Edwards BK (eds). SEER Cancer Statistics Review, 1973-1994. Bethesda, MD: National Cancer Institute; 1997. NIH Publication No. 97-2789.

24. National Cancer Institute. The SEER Program Code Manual. Revised ed. NIH Publication No. 94-1999. Bethesda, MD: National Cancer Institute; 1994.

25. Hanks GE. Patterns of care of breast cancer. In: Fowble B, Goodman RL, Glick JH, and Rosato EF, editors. Breast Cancer Treatment: A Comprehensive Guide to Management. St. Louis, MO: Mosby Year Book; 1991, p. 585-600.

26. U.S. Public Health Services. International Classification of Diseases, 9th Revision, Clinical Modification. 5th ed. Los Angeles: PMIC; 1996.

27. American Medical Association. Physicians' Current Procedural Terminology - CPT 94. Chicago: American Medical Association; 1993.

28. Health Care Financing Administration. HCFA Common Procedure Coding System (HCPCS): National Level II Medicare Codes. Los Angeles, CA: Practice Management Information Corporation, 1994.

29. Health Care Financing Administration. HCFA Data Dictionary: Revenue Center Codes. June 17, 1999.

30. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987;40:373-83.

31. Romano PS, Roos LL, Jollis JG. Adapting a clinical comorbidity index for use with ICD-9-CM administrative data: differing perspectives. J Clin Epidemiol 1993;46:1075-9.

32. SAS Institute Inc. SAS/STAT Software: Changes and Enhancements. Cary, NC: SAS Institute Inc. 1996.

33. Du XL, Freeman JL, Freeman DH, Syblik DA, Goodwin JS. Temporal and regional variation in the use of breast conserving surgery and radiotherapy for older women with early stage breast cancer from 1983 to 1995. J Gerontol Med Sci 1999;54A:474-478.

34. Du XL. Increase in the use of breast-conserving surgery. JAMA 1999;282:326-327.

35. Nattinger AB, Hoffmann RG, Kneusel RT, Schapira MM. Relation between appropriateness of primary therapy for early-stage breast carcinoma and increased use of breast-conserving surgery. Lancet 2000;356:1148-1153.

36. Cabanes PA, Salmon RJ, Vilcoq JR, Durand JC, Fourquet A, Gautier CX, et al. Value of axillary dissection in addition to lumpectomy and radiotherapy in early breast cancer. The Breast Carcinoma Collaborative Group of the Institute Curie. Lancet 1992;339:1245-8.

37. Schapira MM, McAuliffe TL, Nattinger AB. Underutilization of mammography in older breast cancer survivors. Med Care 2000;38:281-289.

38. Krag D, Weaver D, Ashikaga T, Moffat F, Klimberg VS, Shriver C, Feldman S, Kusminsky R, Gadd M, Kuhn J, et al. The sentinel node in breast cancer--a multicenter validation study. N Eng J Med 1998;339:941-946.

39. Wingo PA, Ries LA, Giovino GA, Miller DS, Rosenberg HM, Shopland DR, Thun MJ, Edwards BK. Annual report to the nation on the status of cancer, 1973-1996, with a special section on lung cancer and tobacco smoking. J Natl Cancer Inst 1999;91:675-690.

40. Wingo PA, Ries LA, Rosenberg HM, Miller DS, Edwards BK. Cancer incidence and mortality, 1973-1995: a report card for the U.S. Cancer 1998;82:1197-1207.

Table 1. Receipt of axillary dissection by women with breast cancer who received breast conserving surgery (BCS) between 1988 and 1993 in 9 SEER areas, by patient and tumor characteristics

Patient and tumor characteristics	Number (%) of women receiving BCS* without axillary dissection	Number (%) of women receiving BCS* with axillary dissection	Total
Age (years)			
25-54	931 (10.2)	8173 (89.8)	9104
55-64	835 (15.2)	4674 (84.8)	5509
65-74	1604 (26.0)	4573 (74.0)	6177
75+	3421 (62.2)	2079 (37.8)	5500
Race			
White	6021 (26.0)	17145 (74.0)	23166
Black	463 (26.1)	1313 (73.9)	1776
Other	252 (20.9)	955 (79.1)	1207
Unknown	55 (39.0)	86 (61.0)	141
Marital status			
Married	2588 (17.4)	12276 (82.6)	14864
Unmarried	3866 (36.0)	6876 (64.0)	10742
Unknown	337 (49.3)	347 (50.7)	684
Cancer stage			
Stage I	5143 (28.7)	12750 (71.3)	17893
Stage IIA	1442 (22.4)	4998 (77.6)	6440
Stage IIB	190 (10.8)	1564 (89.2)	1754
Stage II,NOS †	16 (7.9)	187 (92.1)	203
Tumor size (cm)			
<0.5	472 (38.9)	743 (61.1)	1225
0.5-<1.0	1294 (25.0)	3883 (75.0)	5177
1.0-<2.0	2857 (23.9)	9089 (76.1)	11946
2.0-<3.0	1362 (25.2)	4053 (74.8)	5415
3.0-<4.0	466 (30.4)	1066 (69.6)	1532
4.0+	324 (40.4)	478 (59.6)	802
Unknown size	16 (7.9)	187 (92.1)	203
Total	**6791 (25.8)**	**19499 (74.2)**	**26290**

* BCS denotes breast-conserving surgery.

† NOS - not specified.

Table 2. Receipt of radiation therapy and chemotherapy in women aged 65 and older who underwent breast conserving surgery in 1991 through 1993, with or without axillary node dissection*

Surgical treatment categories	Number of patients	Number (%) of women receiving radiation therapy †	Number (%) of women receiving chemotherapy ‡
breast conserving surgery **without** axillary dissection	2215	853 (38.5)	69 (3.1)
breast conserving surgery **with** axillary dissection	3113	2673 (85.9)	249 (8.0)

* For women with early stage (local or regional) breast cancer diagnosed between 1991 and 1993 from the SEER-Medicare linked database.

† Radiation therapy was defined if SEER data indicated so or if there were Medicare claims for radiation therapy within 4 months after diagnosis of breast cancer.

‡ Chemotherapy was defined if patients had at least one Medicare claim for chemotherapy within 12 months after diagnosis.

Table 3. Interaction between receipt of axillary dissection and radiation therapy on breast cancer survival in women aged 65 and older with early stage breast cancer, 1991-1993

Variables	Number of patients (n=5328)	Hazard ratio for 3-year breast cancer specific mortality (95% CI) †
Patients receiving BCS, by receipt of axillary dissection (Ax) and radiation (XRT)*		
No Ax + no XRT	1362	1.76 (1.24-2.49)
No Ax + XRT	853	1.11 (0.74-1.68)
Ax + no XRT	440	1.00 (0.59-1.70)
Ax + XRT	2673	1.00
Other key risk factors in the model		
Age (years)		
65-69	1287	1.00
70-74	1415	1.03 (0.69-1.53)
75-79	1189	1.02 (0.67-1.54)
80+	1437	1.15 (0.76-1.74)
Tumor size (cm)		
<0.5	264	1.00
0.5-<1.0	1252	1.11 (0.42-2.93)
1.0-<2.0	2419	2.07 (0.84-5.12)
2.0-<3.0	968	3.51 (1.40-8.77)
3.0-<4.0	255	6.76 (2.62-17.44)
4.0+	138	5.50 (2.00-15.12)
Unknown size	32	2.52 (0.89-7.09)
Comorbidity index scores ‡		
No Medicare claims	344	0.82 (0.44-1.54)
0	3616	1.00
1	637	1.53 (1.06-2.22)
2	323	1.76 (1.11-2.79)
3+	408	2.05 (1.37-3.05)

* BCS (breast-conserving surgery), No Ax (no axillary dissection); no XRT (no radiation therapy); Ax (axillary dissection); XRT (radiation therapy).

† Hazard ratios (95% confidence interval), adjusted for the variables listed in the table and also adjusted for marital status (married, unmarried and unknown), race (white, black, and other), and 9 SEER areas.

‡ Comorbidity was assessed by a validated algorithm[29,30] using Medicare claims.

Legend for Figure 1.

Figure 1. Kaplan-Meier breast cancer specific survival curve for women with early stage breast cancer, stratified by breast-conserving surgery (BCS) with and without axillary dissection.

The 7-year breast cancer specific survival curves are shown for women diagnosed with breast cancer diagnosed in 1988-1989. The log rank test for survival curves between BCS without axillary dissection and BCS with axillary dissection was statistically significant for two groups (P=0.0001). Data are for all women aged 25 and older diagnosed with early stage breast cancer in one of the 9 SEER areas in 1988 and 1989 (n=6,318), and followed though 1996 from SEER Public Use Data Set.

Persistent Differences in Socio-demographic Determinants of Use of Breast Conserving Surgery Despite Overall Increased Adoption

Mary Ann Gilligan, MD, MPH

Ronald T. Kneusel, MS

Raymond G. Hoffmann, PhD

Ann L. Greer, PhD

Ann B. Nattinger, MD, MPH

From the Departments of Medicine (M.A.G., R.T.K., R.G.H.) and Biostatistics (R.G.H.) Medical College of Wisconsin and the Department of Sociology, University of Wisconsin-Milwaukee (A.L.G.) Address reprint requests to: Mary Ann Gilligan, MD, MPH, Division of General Internal Medicine, Froedtert East Office Building, Suite 4200, 9200 West Wisconsin Avenue, Milwaukee, WI 53226.

Grant support from Department of Defense, Grant #DAMD 17-96-1-6262 and American Cancer Society CCCDA-99-291-01.

INTRODUCTION

Although randomized clinical trials are generally regarded as the highest level of evidence guiding clinical care [1], studies have shown substantial lag time before the results of such trials are incorporated into clinical practice [2-5]. In the case of breast-conserving surgery (BCS) as therapy for early stage breast cancer, the first U.S. randomized trial showing equal 5-year survival with BCS or mastectomy treatment was published in 1985 [6]. Although the use of BCS rose moderately from 1983 to 1985, the use of BCS was virtually flat over the first several years after the 1985 randomized trial publication [4, 7, 8] and did not rise further until 1990 [9, 10].

In addition to slow early adoption, BCS treatment has been characterized by variation in level of use by patient factors such as age [11-13], geography [5, 12], urban vs. rural residence [4, 5, 14], and socioeconomic status [15].

One might expect some variation in use of a new therapy early in its adoption due to the time it takes for dissemination of information and acceptance into physician practice. Such variation should decrease once the therapy becomes better established. In our study, we hypothesized that variation in the use of BCS by demographic patient factors would decrease after the NIH Consensus Conference held in January 1990. The consensus statement from this conference held that BCS treatment with radiotherapy was

not only appropriate for women with early stage breast cancer, but that it was preferable because it provided equivalent survival while preserving the breast [16].

METHODS

Databases

SEER National Tumor Registry Files. The National Cancer Institute's SEER program consists of a group of population-based tumor registries, each of which provides data to the national program. The nine sites analyzed in this study include five whole states (CT, HI, IA, NM, UT), and four metropolitan areas (Atlanta, Detroit, San Francisco-Oakland, and Seattle-Puget Sound)[17].

The SEER registries function according to a standardized set of procedures. Incident cancers in persons residing within the coverage areas are determined from hospitals, offices, and some freestanding centers. For each subject with an incident breast cancer, information is abstracted regarding demographics, stage of disease, and initial therapy administered or planned within 4 months.

United States Census Data. We used the U.S. 1990 Census files to provide estimates of socioeconomic data for patients in the study cohort [18]. For each patient, we determined the mean per capita income, percentage who had completed high school, and size of the metropolitan statistical area for the county of residence.

Study Subjects

A cohort of 158,498 women was selected from 238,005 women diagnosed with breast cancer between 1983 and 1996. BCS use was calculated for each quarter based on date (month and year). Women were excluded for the following reasons: the cancer was *in situ*, distant or unstaged; breast cancer was not the patient's first cancer; no microscopic confirmation of disease; patient did not receive either a mastectomy or BCS; age at diagnosis was less than 30; or breast cancer was bilateral.

Age at diagnosis was categorized as 30-49, 50-64, 65-79, and 80 and older. Race was categorized as white or nonwhite. Women were considered to have received BCS if they underwent segmental mastectomy, lumpectomy, quadrantectomy, tylectomy, wedge resection, excisional biopsy, or partial mastectomy. The size of the metropolitan statistical area (MSA) of the county of residence of the patient was categorized as follows: 1) more than 1 million persons (MSA=1); 2) 100,000 to 1 million persons (MSA=2,3,4); or 3) <100,000 persons or rural (MSA=0). The per capita income (PCI) of the county of residence of the patient was categorized into quartiles: 1) less than or equal to $13,016, 2) $13,017-$17,115, 3) $17,116-$18,983, and 4) >$18,983. Likewise, educational status was categorized by quartiles based on the percent of high school graduates in the county of residence of the patient: 1) less than or equal to 77.69%, 2) 77.7-81.21%, 3) 81.22-84.71%, and 4) 84.72-91.95%.

Statistical Analysis

We modeled the probability of receipt of BCS for each individual with logistic regression. Piecewise linear splines were used to model change over time. Knots, or join points, for the splines were based on overall use of BCS between 1983-1996. We identified five time segments based on overall use of BCS: 1) an early phase from 1983-84, 2) a 6-month period of rapid rise in BCS use during the first 2 quarters of 1985, 3) a period of stable use from the 3rd quarter of 1985 through the 4th quarter of 1989, 4) a 6-month period of decline in BCS use within the stable period previously shown to be attributable to a celebrity role model who underwent mastectomy [8], and 5) a late phase beginning in the 1st quarter of 1990 and continuing through 1996. Accordingly, knots were placed at 1st quarter 1985, 2nd quarter 1985, 3rd quarter 1985, 4th quarter 1987, 1st quarter 1988, and 1st quarter 1990. A logistic regression model predicting BCS use by age, education, income, population density, and SEER site was created to simultaneously adjust for each of the other factors. The model was applied separately to each of the subgroups of the factors being studied. Age was analyzed stratified by stage of disease (local, regional) because there was a significantly different pattern between the two stages. The Hosmer-Lemeshow test [19] was performed to assess goodness-of-fit for each model.

The results of the logistic regression were used to evaluate the variability in use of BCS over time by the factors. Three aspects of variation were assessed for the subgroups of each factor. First, the order or ranking of subgroups of the factor with respect to adjusted use of BCS was determined for the calendar years of 1983 and 1996. Statistical differences in the rankings of the subgroups were sought by performing Wald z-tests[19] of the standard errors for each subgroup compared to the others. Second, the spread was calculated as the difference between the adjusted means of the highest and lowest use subgroup in 1983, 1986, 1990, and 1996. Wald Z-tests [19] were performed to determine significant differences. Third, the slopes of the subgroups of each factor were compared in the late period (1990-1996). A Tukey's HSD (Honestly Significant Difference) was used for multiple comparison adjustment. The overall p-value was set to 0.05.

RESULTS

Of the 158,498 patients, 24.3% were aged 30-49, 31.8% were 50-64 years, 33.6% were 65-79 years, and 10.4% were 80 and older. Eighty-seven percent were white, and 65.6% had local stage disease. Over the 14 years of study, 34.6% underwent BCS. Consistent with previous reports [4, 7-10] absolute use of BCS increased from 13.9% in 1983 to 53.6% in 1996.

Change in Use of BCS by Age

Patterns of use of BCS by age differed for local and regional stage disease and, therefore, were examined separately. Among women with local stage disease, those aged 80 and older had the highest BCS use in 1983 ($p < 0.001$), and women aged 30-49 had the next highest use ($p < 0.001$) (Figure 1, top). By 1996, the ordering of the age groups with respect to BCS use had changed substantially. The use of BCS among women 80 and older was now significantly lower than among women 50-64 ($p < 0.001$) and no longer differed significantly from women aged 30-49 or aged 65-79 years. By 1996, the use among women aged 30-49 years was intermediate, and no longer differed significantly from any other age group. Between 1983 and 1986 the spread between the highest and lowest use age groups decreased ($p = 0.01$), after which it remained constant through 1996. With respect to slope, or rate of change in BCS use from 1990-1996, women aged 30-49 and 80 and older had significantly smaller slopes than women in other age groups over this time ($p < 0.001$). This finding may predict even lower relative use of BCS in these age groups in future years.

Figure 1, bottom, shows BCS use by age for women with regional stage disease. In 1983, the oldest and youngest age groups had greater use of BCS than the middle two age groups ($p < 0.003$). By 1996, women aged 80 and older had significantly lower use than all other age groups ($p < 0.005$), and women aged 65-79 had lower use than younger women ($p < 0.001$). In contrast to the pattern with local stage disease, the spread between

highest and lowest use age groups remained constant through 1990, then increased between 1990 -1996 ($p < 0.01$).

Change in Use of BCS by Socioeconomic Status

In 1983, the women in the two wealthiest quartiles of per capita income had use of BCS which was higher than use among women in the 3rd quartile ($p < 0.001$), which itself was higher than use among women in the poorest quartile ($p < 0.001$) (Figure 2). By 1996, use was ordered by wealthiest to poorest quartile, with each quartile differing significantly from the others ($p < 0.001$ for each). A significant increase in spread occurred between 1983 and 1986 ($p = 0.0012$) which increased even further between 1990-1996 ($p < 0.001$). From 1990 to 1996, the slopes between the quartiles of income did not differ, suggesting that these differences may persist into the near future.

In 1983, women in the lower two quartiles of educational status had lower use of BCS than women in each of the upper quartiles ($p < 0.001$). By 1996, use of BCS among women in the lowest education quartile was significantly less ($p < 0.001$) than among women in the better-educated quartiles which, in turn, did not differ from each other. There was no significant change in the spread between1983 and 1996. The slope between 1990 and 1996 was similar between the highest and lowest education groups and likewise between the middle two education groups. The slope is significantly greater in the middle two groups than in the best and least educated groups ($p < 0.006$).

Change in Use of BCS by Population Density and Region

In 1983, there was greater use of BCS in more highly urban areas ($p < 0.001$) (Figure 3). By 1996, the two most urban categories have similar use, and both have significantly greater use than the least urban category ($p < 0.001$). The spread between highest and lowest use groups increased by 1990 ($p = 0.014$) and thereafter remained stable. From 1990 to 1996, the slope of the second most urban group is significantly greater than that of the most urban ($p < 0.001$).

While there were some minor changes in the ordering among the SEER sites, substantial geographic variation in use of BCS persisted through 1996 (Figure 4). The spread in use decreased significantly between 1983 and 1986 ($p = 0.0015$) and then remained constant through 1996.

DISCUSSION

In this paper, we have shown that the use of BCS has increased over time among all subgroups of age, income, education, population density, and geographic location. However, we did not find the expected decreased variation in use of BCS by 1996. In fact, the only significant and sustained decrease in spread was observed for the characteristic of age among women with local stage disease. Among women with regional stage disease, the spread in use between age groups actually increased between 1990 and 1996. In addition, the differential use early in the adoption of BCS based on socioeconomic status, population density, and geographic location persisted over the entire 14-year period of observation. In the case of each of these factors, the slopes from

1990 to 1996 suggest that differential use by subgroups is likely to persist, at least into the foreseeable future.

An extensive literature has accumulated on changing physician's practices. This literature has documented generally disappointing results in attempts to change practices with the use of educational strategies [20], NIH consensus statements [20, 21], and clinical practice guidelines [21, 22]. Rather, changes in practice may depend more on the organization of local medical practice communities [22, 23], less formal channels of dissemination of information [24], and market competition factors [23, 25]. However, few have studied physician practice change with respect to patient subgroups. During the period of time we studied the use of BCS, there was substantial overall change in the patterns of practice with respect to BCS, as shown by the dramatic increases in the use of this technique. Yet, there was remarkably little change in the relative use among patients of different socioeconomic strata, urban vs. rural residence, and geographic location.

The persistent differences in use of BCS by socioeconomic status are particularly compelling. Early in the diffusion of a new treatment, physician knowledge of the treatment options would tend to play a critical role in the variation in use. However, the persistently higher BCS use among women of higher socioeconomic status over time suggests other factors at play. We believe this persistent variation in use reflects, in good part, underlying differences in patient beliefs and values[26]. While the focus in the

literature of technology diffusion has primarily been on the adopter rather than the recipient of the technology, the findings may be applicable to the recipients as well. The personal attributes of early adopters include 1) they have more years of formal education, 2) are more likely to be literate, and 3) have a greater ability to deal with abstractions than do later adopters [27]. In the case of breast-conserving treatment for early stage breast cancer, for example, better-educated women may be more likely to be aware of and seek out treatment options even if not initially offered by their physician. Better -educated patients may be more willing to accept the rather abstract notion that an irradiated cancer is just as "gone" as a cancer that has been surgically removed. On a more practical level, these differences may be a reflection of women opting for a treatment that requires the least time away from work, or the least time away from daily tasks and obligations.

The changing pattern of relative use of BCS by age described here may explain disagreement among previous authors regarding use of BCS by age. Some previous studies have shown higher BCS use among older women and some have shown lower use. The reason for these apparent discrepancies is likely due to the time period studied. In two studies which found that women aged 80 and older had greater use of BCS, the time period analyzed was 1983-1986 [11, 14], a time during which the current study also finds high use among women aged 80 and older. By about 1986, the use of BCS among women under 50 years exceeded the use by women aged 80 and older, explaining the fact

that studies of years after 1985 found lower use among women aged 80 and older [4, 9, 10, 28]. In our statistical model, BCS use was calculated quarter by quarter over the entire period of study enabling highly accurate interpretation of BCS use by year. In future studies of BCS use by age, it will be important for investigators to consider the changing use of BCS by age over time.

Our findings on population density confirm previous studies that have found an association between increased use of BCS and more urban residence [5, 14]. Other studies have found an association between greater use of BCS and large hospital size[7, 29] and also the presence of radiation facilities[4, 5, 7, 28], both of which are also related to urban location of the hospital. The fact that the differential use of BCS by population density has increased over time supports the view that the urban-rural discrepancy in use of BCS is more likely attributable to access issues, or different beliefs or values, than to lack of knowledge about the newer therapy. Again, this suggests systematic decision making by physicians and patients based on logistical realities of the treatment options presented.

A limitation of our study is that the population residing within the SEER areas is more affluent and more urban than the remainder of the United States [30]. However, given that rates of breast conserving treatment are higher in more affluent and urban women, we would anticipate an even greater discrepancy between groups if we could study the general population. Our measures of socioeconomic status are ecologic, and based on

county level data. Unfortunately, the national SEER database does not include census tract information that would allow a more accurate estimate of income and educational status. However, any resulting misclassification should be non-differential, which, if anything, would make it harder to detect differences between subgroups. This makes our positive findings all that much more significant.

Conclusion

Our analysis confirms that demographic differences in BCS use have persisted for more than 10 years after the publication of the first U.S. randomized trial of this therapy. The fact that these differences have persisted for so long suggests that they are not due simply to lack of physician knowledge about treatment options for early stage breast cancer. Rather, the differences may be a reflection of patient decision making based on their own beliefs and values given two equally effective treatments. Just as the optimal rate for overall BCS use is not necessarily 100%, the optimal rate may vary by age, income, education and location of the patient, as well as other variables not evaluated in this study. In the case of treatment for early stage breast cancer, it is conceivable that practice variation is even a marker of success in terms of physicians listening to patients and incorporating their values and beliefs into treatment decisions.

Legend

Figure 1

Use of breast-conserving surgery for early stage breast cancer by subgroups of age, over the time period 1983-1996. The top graph is based on women with local stage disease, and the bottom reflects women with regional stage disease. Plotted points are based on a logistic regression model that simultaneously adjusts for socioeconomic status, race, population density and SEER site as described in the text.

Legend

Figure 2

Use of breast-conserving surgery for early stage breast cancer by per capita income (PCI), 1983-1996, based on a logistic regression model simultaneously adjusting for SES, race, population density and SEER site.

Legend

Figure 3

Use of breast-conserving surgery for early stage breast cancer by population density, 1983-1996, based on a logistic regression model simultaneously adjusting for SES, race, population density and SEER site.

Legend

Figure 4

Use of breast-conserving surgery for early stage breast cancer by SEER site, 1983-1996, based on a logistic regression model simultaneously adjusting for SES, race and population density.

REFERENCES

1. Sackett DL, Haynes RB, Tugwell P. Clinical epidemiology: A basic science for clinical medicine. . First ed. Boston/Toronto: Little, Brown and Company; 1985.

2. Sial SH, Malone M, Freeman JL, Battiola R, Nachodsky J, Goodwin JS. Beta blocker use in the treatment of community hospital patients discharged after myocardial infarction. *J Gen Int Med.* 1994;9:599-605.

3. Lau J, Chalmers TC. The rationa use of therapeutic drugs in the 21st century. Important lessons from cumulative meta-analyses of randomized control trials. *Intl J Tech Assess Health Care.* 1995;11:509-22.

4. Lazovich D, White E, Thomas DB, Moe RE. Underutilization of breast-conserving surgery and radiation therapy among women with stage I or II breast cancer. *JAMA.* 1991;266:3433-3438.

5. Nattinger AB, Gottlieb MS, Veum J, Yahnke D, Goodwin JS. Geographic variation in the use of breast-conserving treatment for breast cancer. *New England Journal of Medicine.* 1992;326:1102-1107.

6. Fisher B, Bauer M, Margolese R, et al. Five-year results of a randomized clinical trial comparing total mastectomy and segmental mastectomy with or without radiation in the treatment of breast cancer. *New England Journal of Medicine.* 1985;312:665-673.

7. Nattinger AB, Gottlieb MS, Hoffman RG, Walker AP, Goodwin JS. Minimal increase in use of breast-conserving surgery from 1986-1990. *Medical Care.* 1996;34:479-489.

8. Nattinger AB, Hoffmann RG, Howell-Pelz A, Goodwin JS. Effct of Nancy Reagan's mastectomy on choice of surgery for breast cancer by US women. *JAMA.* 1998;279:762-766.

9. Lazovich D, Solomon CC, Thomas DB, Moe RE, White E. Breast conservation therapy in the United States following the 1990 National Institutes of Health Consensus Development Conference on the Treatment of Patients with Early Stage Invasive Breast Carcinoma. *Cancer.* 1999;86:628-37.

10. Morris CR, Cohen R, Schlag R, Wright WE. Increasing trends in the use of breast-conserving surgery in California. *American Journal of Public Health.* 2000;90:281-284.

11. Chu J, Diehr P, Feigl P, Glaefke G, Begg C, Glicksman A. The effect of age on the care of women with breast cancer in community hospitals. *Journal of Gerontology.* 1987;42:185-190.

12. Farrow DC, Hunt WC, Samet JM. Geographic variation in the treatment of localized breast cancer. *New England Journal of Medicine.* 1992;326:1097-1101.

13. Mann B, Samet J, Hunt W, Key C, Goodwin J, Goodwin J. Changing treatment of breast cancer in New Mexico from 1969 through 1985. *JAMA.* 1988;259:3413-3417.

14. Samet J, Hunt W, Farrow D. Determinants of receiving breast-conserving surgery: the Surveillance, Epidemiology and End Results Program, 1983-1986. *Cancer.* 1994;73:2344-51.

15. Michalski TA, Nattinger AB. The influence of balck race and socioeconomic status on the use of brast-conserving surgery for medicare beneficiaries. *Cancer.* 1997;79:314-9.

16. NIH CC. Treatment of early-stage breast cancer. . *JAMA*; 1991:391-395.

17. Surveillance E, and End Results (SEER) Program Public Use CD-ROM. National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics. ; Released 1999.

18. Krieger N. Overcoming the absence of socioeconomic data in medical records: Validation and application of a census-based methodology. *Am J Public Health.* 1992;82:703-710.

19. Hosmer DW, Lemeshow S. Applied logistic regression. . New York: John Wiley and Sons; 1989.

20. Greco PJ, Eisenberg JM. Changing physicians' practices. *N Engl J Med.* 1993;329:1271-4.

21. Kosecoff J, Kanouse DE, Rogers WH, McCloskey L, Winslow CM, Brook RH. Effects of the National Institutes of Health consensus development program on physician practics. *JAMA.* 1987;258:2708-13.

22. Cabana MD, Rand CS, Power NR, al. e. Why don't physicians follow clinical practics guidelines? *JAMA*. 1999;282:1458-65.

23. Greer AL. The state of the art verus the state of the science: the diffusion of new medical technologies into practics. *Intl J Technol Assess Health Care*. 1988;4:5-26.

24. Ramsey SD, Hillman AL, Renshaw LR, Kimberly JR, Pauly MV, Schwartz JS. How important is the scientific literature in guiding clinical decisions? *Intl J Technol Assess Health Care*. 1993;9:253-262.

25. Escarce JJ, Bloom BS, Hillman AL, Shea JA, Schwartz JS. Diffusion of laparoscopic cholecystectomy among general surgeons in the United States. *Medical Care*. 1995;33:256-271.

26. Greer AL. personal communication. ; 2000.

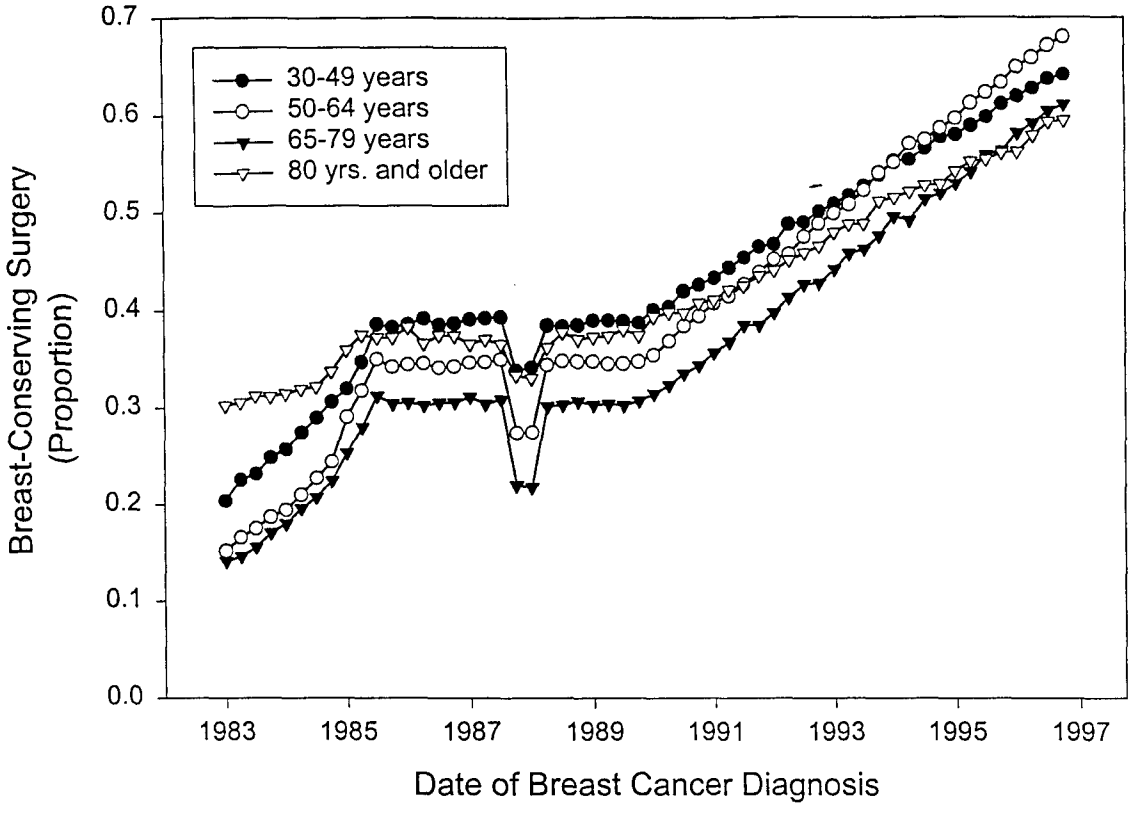
27. Rogers EM. Diffusion of Innovations. . 4th ed. New York: Free Press; 1995.

28. Lazovich D, White E, Thomas DB, Moe RE, Taplin S. Change in the use of breast-conserving surgery in western Washington after the 1990 NIH consensus development conference. *Archives of Surgery*. 1997;132:418-423.

29. Kotwall CA, Covington DL, Rutledge R, Churchill MP, Meyer AA. Patient, hospital, and surgeon factors associated with breast conservation surgery. *Annals of Surgery*. 1996;224:419-429.

30. Nattinger AB, McAuliffe TL, Schapira MM. Generalizability of the Surveillance, Epidemiology, and End Results registry population: factors relevant to epidemiologic and health care research. *Journal of Clinical Epidemiology*. 1997;50:939-945.

Figure 1


30-49 years
50-64 years
65-79 years
80 yrs. and older
Breast-Conserving Surgery (Proportion)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
1983
1985
1987
1989
1991
1993
1995
1997
Date of Breast Cancer Diagnosis

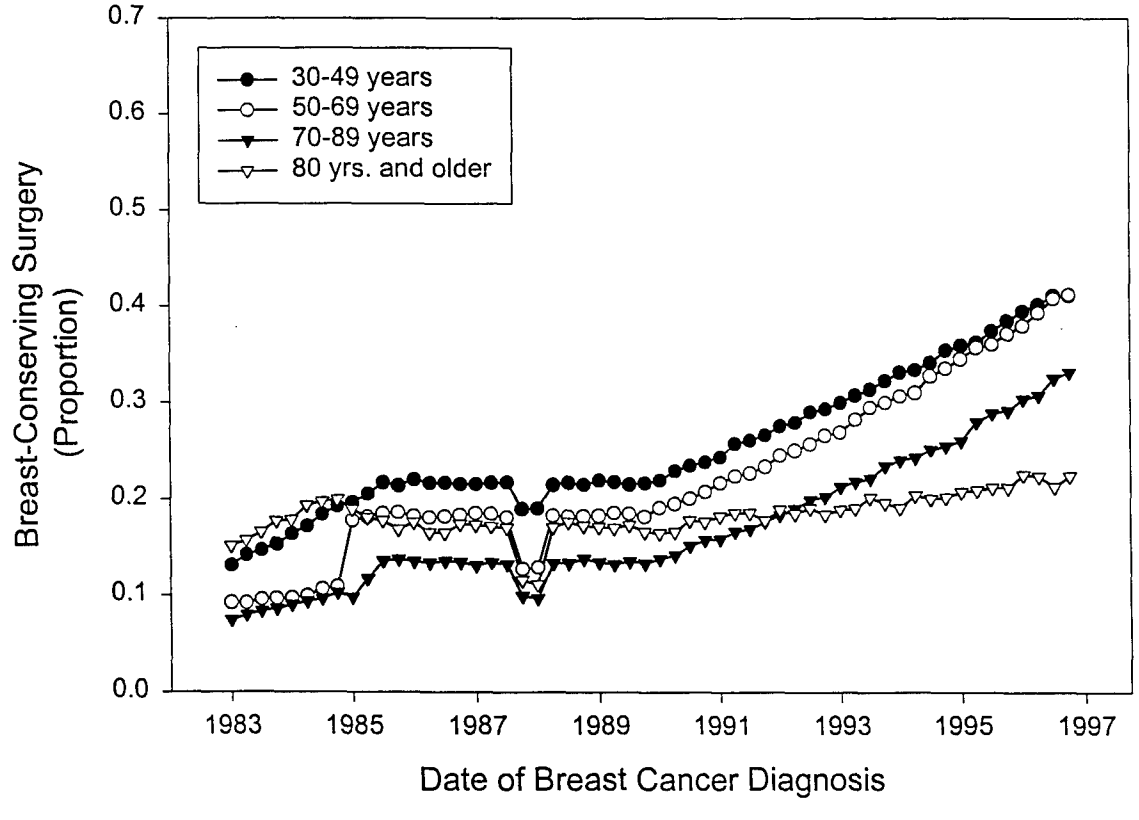

30-49 years
50-69 years
70-89 years
80 yrs. and older
Breast-Conserving Surgery (Proportion)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
1983
1985
1987
1989
1991
1993
1995
1997
Date of Breast Cancer Diagnosis

Figure 2

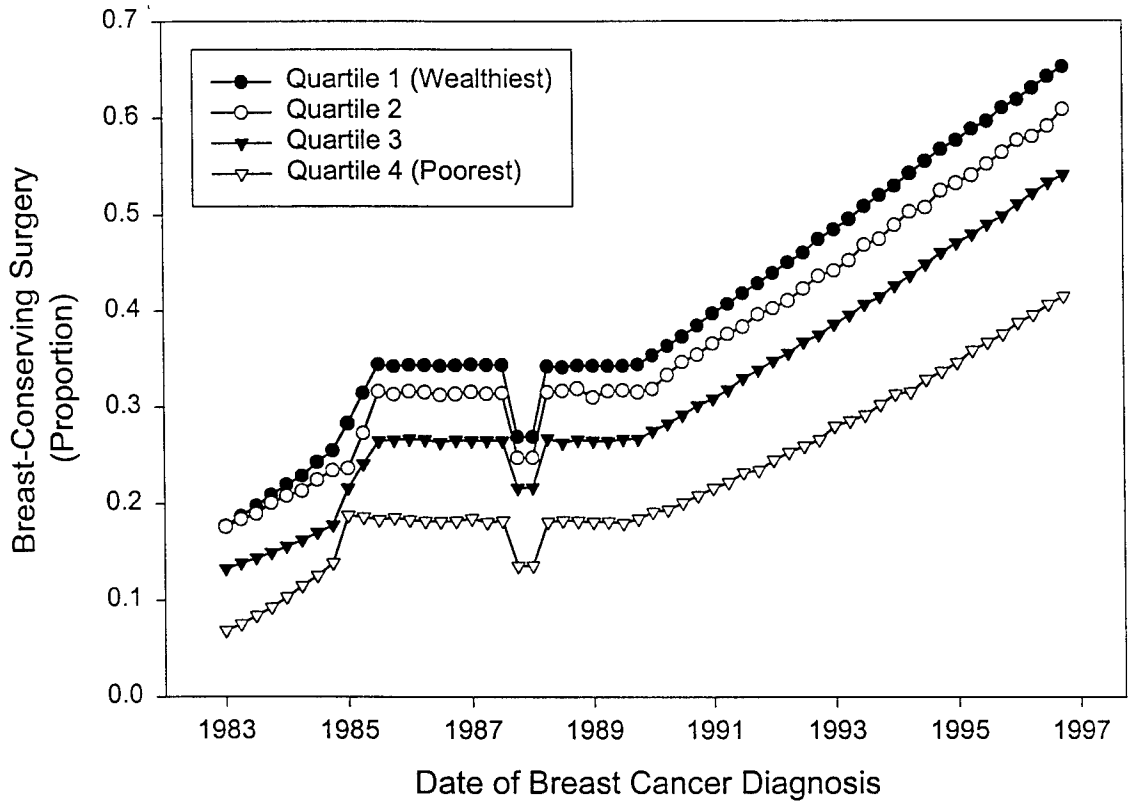

Quartile 1 (Wealthiest)
Quartile 2
Quartile 3
Quartile 4 (Poorest)
Breast-Conserving Surgery (Proportion)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
1983
1985
1987
1989
1991
1993
1995
1997
Date of Breast Cancer Diagnosis

Figure 3

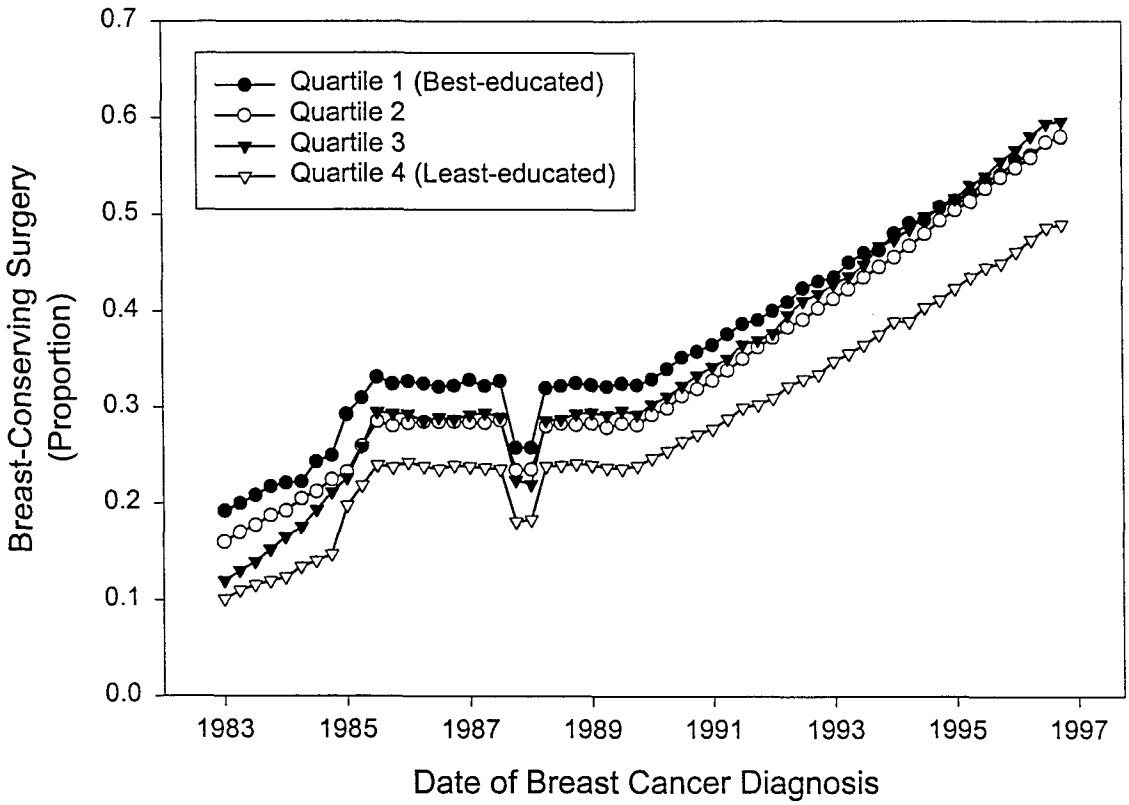

Quartile 1 (Best-educated)
Quartile 2
Quartile 3
Quartile 4 (Least-educated)
Breast-Conserving Surgery (Proportion)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
1983
1985
1987
1989
1991
1993
1995
1997
Date of Breast Cancer Diagnosis

Figure 4

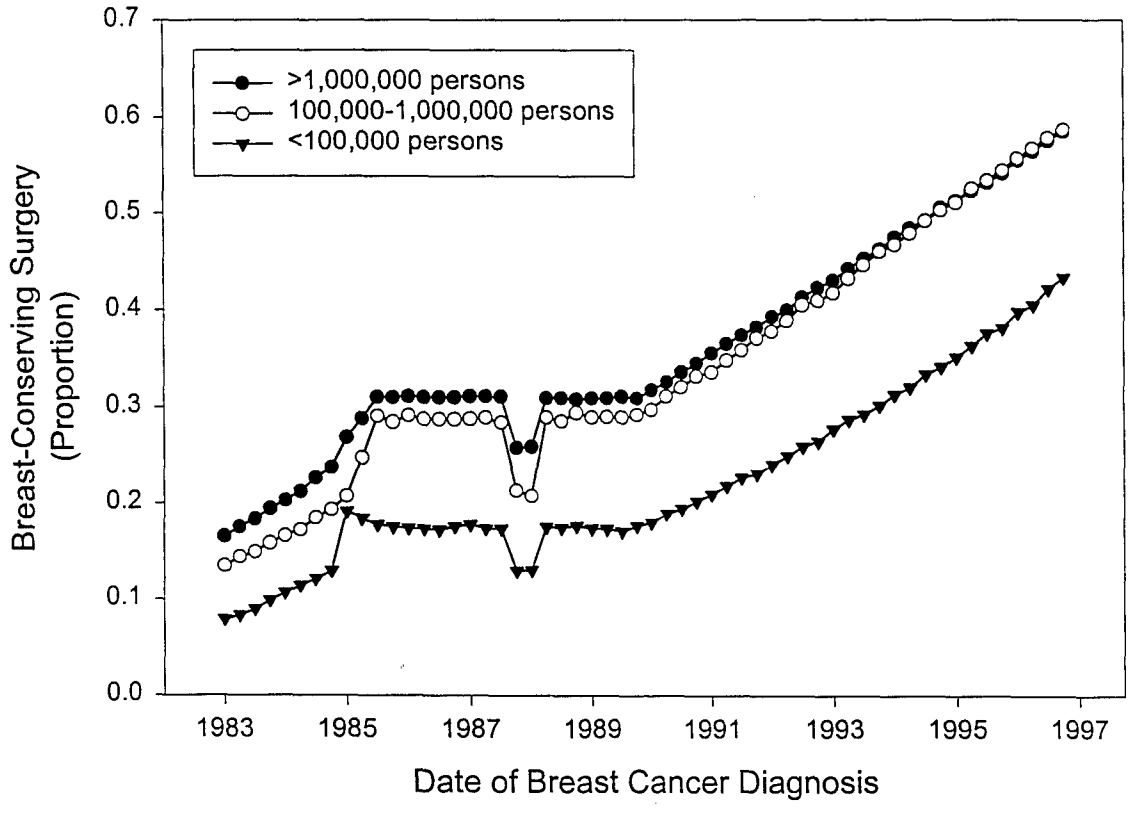
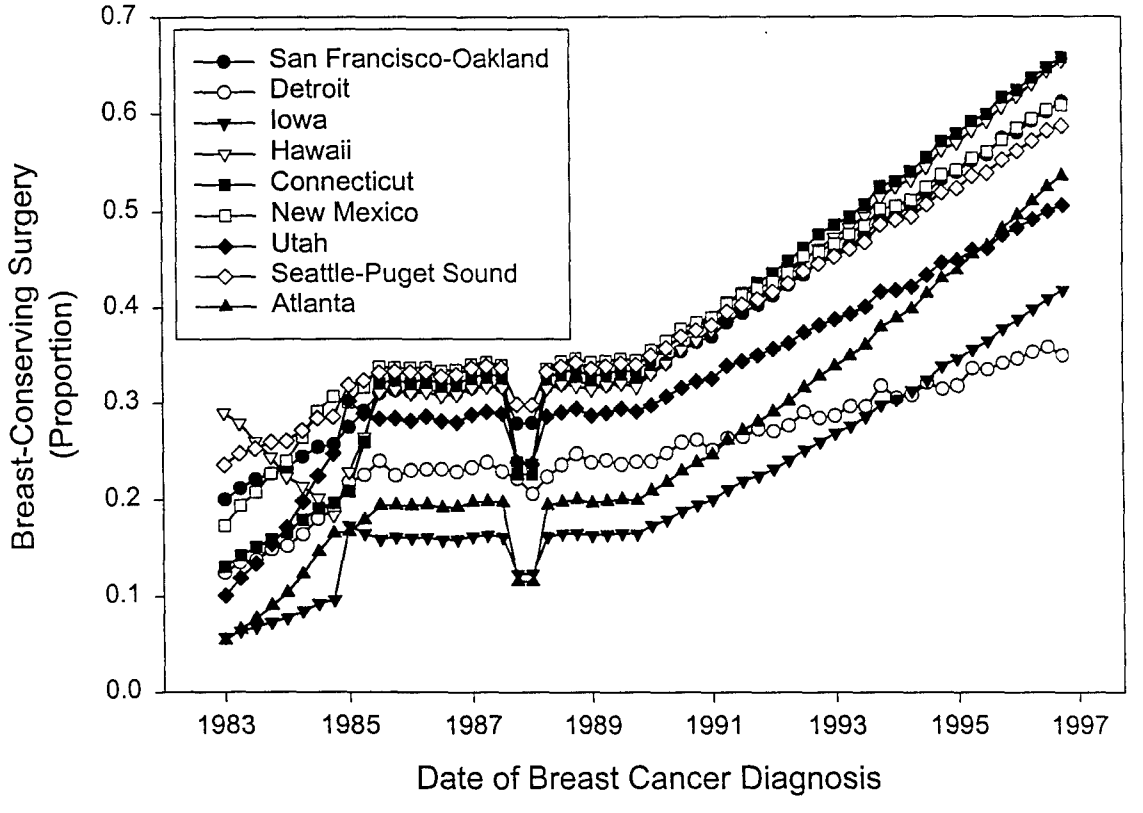

0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
>1,000,000 persons
100,000-1,000,000 persons
<100,000 persons
Breast-Conserving Surgery
(Proportion)
1983
1985
1987
1989
1991
1993
1995
1997
Date of Breast Cancer Diagnosis

Figure 5


0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Breast-Conserving Surgery (Proportion)
San Francisco-Oakland
Detroit
Iowa
Hawaii
Connecticut
New Mexico
Utah
Seattle-Puget Sound
Atlanta
1983
1985
1987
1989
1991
1993
1995
1997
Date of Breast Cancer Diagnosis

MEDICAL CARE
Volume 38, Number 7, pp 719–727

Accuracy and Completeness of Medicare Claims Data for Surgical Treatment of Breast Cancer

XIANGLIN DU, MD, PHD,* JEAN L. FREEMAN, PHD,* JOAN L. WARREN, PHD,†
ANN B. NATTINGER, MD, MPH,‡ DONG ZHANG, PHD,§ AND JAMES S. GOODWIN, MD*

BACKGROUND. Although a number of studies have used Medicare claims data to study trends and variations in breast cancer treatment, the accuracy and completeness of information on surgical treatment for breast cancer in the Medicare data have not been validated.

OBJECTIVES. This study assessed the accuracy and completeness of Medicare claims data for breast cancer surgery to determine whether Medicare claims can serve as a source of data to augment information collected by cancer registries.

METHODS. We used the Surveillance, Epidemiology and End Results (SEER) Cancer Registry–Medicare data and compared Medicare claims on surgery with the surgery recorded by the SEER registries for 23,709 women diagnosed with breast cancer at ≥65 years of age from 1991 through 1993.

RESULTS. More than 95% of women having mastectomies according to the Medicare data were confirmed by SEER. For breast-conserving surgery, 91% of cases were confirmed by SEER. The Medicare physician services claims and inpatient claims were approximately equal in accuracy on type of surgery. The Medicare outpatient claims were less accurate for breast-conserving surgery. In terms of completeness, when the 3 claims sources were combined, 94% of patients receiving breast cancer surgery according to SEER were identified by Medicare.

CONCLUSIONS. The combined Medicare claims database, which includes the inpatient, outpatient, and physician service claims, provides valid information on surgical treatment among women known to have breast cancer. The claims are a rich source of data to augment the information collected by tumor registries and provide information that can be used to follow long-term outcomes of Medicare beneficiaries.

Key words: breast cancer; mastectomy; breast conserving surgery; SEER; Medicare. (Med Care 2000;38:719–727)

Administrative databases have been increasingly utilized in studies of health care outcomes over the past decade.[1–8] For example, Medicare claims data have been used to estimate the incidence of breast cancer,[4–7] to examine treatment patterns for breast cancer,[8,9] and to study clinical surveillance of breast cancer, such as postoperative use of radiotherapy.[10,11] Although Medicare claims data have been found to

*From the Department of Internal Medicine and Sealy Center on Aging, University of Texas Medical Branch, Galveston.

†From the Applied Research Branch, National Cancer Institute, Bethesda, Maryland.

‡From the Division of General Internal Medicine, Medical College of Wisconsin, Milwaukee.

§From the Office of Biostatistics and Sealy Center on Aging, University of Texas Medical Branch, Galveston.

This study was supported by grants from the Department of Defense (DAMD17-97-1-709-5, DAMD17-96-6262, and DAMD17-99-1-9397), the National Cancer Institute (CA72076), and the Sealy & Smith Foundation.

Presented in part at the Association for Health Services Research Annual Meeting, Los Angeles, California, June 25–27, 2000.

Address correspondence to: Xianglin Du, MD, PhD, Department of Internal Medicine, University of Texas Medical Branch, 301 University Blvd, Galveston, TX 77555-0460. E-mail: xdu@utmb.edu

Received July 13, 1999; initial review completed October 8, 1999; accepted February 8, 2000.

be useful for research, there are some concerns, including the accuracy of the diagnostic and procedure coding,[1–6,12] demographic coding errors,[2,11] incomplete coverage of all Medicare beneficiaries,[2,12] and completeness of the claims.[2,11,13] Recently, Cooper and colleagues[14] found that the sensitivity of Medicare data for detection of breast cancer was reasonably high, especially if Medicare parts A and B are combined and surgical procedure codes were used. On the other hand, Warren et al[7,15] determined that the diagnostic codes from Medicare hospital claims had high predictive value for breast cancer incidence but that the diagnoses from the physician claims had low predictive value. Medicare data also have limited utility for measuring cancer stage.[16]

The accuracy and completeness of information on surgical treatment for breast cancer in Medicare data, however, have not been validated, even though a number of studies have used Medicare claims data to study trends and variations in breast cancer treatment.[8–11,17] Although the coding and completeness of mastectomies in the inpatient claims appear to be very good,[12,18] the accuracy and completeness of information on breast-conserving surgery (BCS) are not known. In particular, the increasing use of BCS[8,19] and the shift to more outpatient treatment[20] have raised questions about the completeness and accuracy of claims for surgery performed outside the hospital.

This study was conducted to assess the accuracy and completeness of Medicare data for breast cancer surgery through the use of all available Medicare claims sources: hospital inpatient, hospital outpatient, and physician services data. Of interest is the extent to which the claims provide information on breast cancer–related surgery in the first course of therapy and whether the type of surgery is confirmed by an external source of data. The overall goal is to determine, with the use of a cohort of women reported by cancer registries as having breast cancer, whether Medicare claims can serve as a source of data to augment information collected by cancer registries and be used to describe surgical treatment patterns in older women with breast cancer.

Methods

Data Sources

We used the merged Surveillance, Epidemiology and End Results (SEER)–Medicare database for this analysis. The SEER program, supported by the National Cancer Institute, includes population-based tumor registries in selected geographic areas. In 1992, these areas included the metropolitan areas of San Francisco–Oakland, Detroit, Atlanta, and Seattle; Los Angeles County; the San Jose–Monterey area; and the states of Connecticut, Iowa, New Mexico, Utah, and Hawaii.[21] These areas cover ~14% of the US population.[21] The registries ascertain all newly diagnosed (incident) breast cancer cases from multiple reporting sources, such as hospitals, outpatient clinics, laboratories, private medical practitioners, nursing/convalescent homes/hospices, autopsy reports, and death certificates.[13,22,23] Information includes tumor location, size, and histological type; such demographic characteristics as age, gender, race, and marital status; and types of treatment provided within 4 months of the date of diagnosis.[22] In the case of surgery, SEER records the most invasive surgery.

The Medicare program is administered by the Health Care Financing Administration (HCFA). It covers hospital, physician, and other medical services for >97% of persons ≥65 years of age.[13,23] The Medicare claims data used in the study included the following 3 files: (1) Medicare Provider Analysis and Review File, which contains inpatient hospital claims; (2) the Hospital Outpatient Standard Analytic File, which contains the claims for outpatient facility services; and (3) the 100% Physician/Supplier File, which contains the claims for physicians' and other medical services. These data were available for all beneficiaries starting in 1991. Therefore, we used all cases diagnosed between January 1, 1991, and December 31, 1993.

Cases reported by the SEER registries from 1973 to 1993 have been matched against Medicare's master enrollment file. Of persons ≥65 of age appearing in the SEER records, Medicare eligibility could be identified for 94%. The method of linking these data has been described elsewhere.[13,20] For SEER cases found to be Medicare eligible, their claims are available through 1994.

Study Population

The study population consisted of all female patients diagnosed with breast cancer at ≥65 years of age between 1991 and 1993. Excluded were women who did not have full coverage of both Medicare parts A and B or who were members of

HMOs in the year of diagnosis because claims from these organizations may not be included in the HCFA databases. Also excluded were 61 patients whose month of diagnosis was unknown and 126 patients with no information from SEER on surgical treatment. This left 23,709 patients for analysis (8,022 in 1991, 8,056 in 1992, and 7,631 in 1993).

Variable Definitions

Breast Cancer–Directed Surgery In SEER, BCS was defined as segmental mastectomy, lumpectomy, quadrantectomy, tylectomy, wedge resection, nipple resection, excisional biopsy, or partial mastectomy unspecified, with or without dissection of axillary lymph nodes. Mastectomy was defined as subcutaneous, total (simple), modified radical, radical, or extended radical mastectomy.

In Medicare, BCS was defined with the following codes: ICD-9-CM[24] procedure codes 8521 (local excision), 8522 (quadrantectomy), or 8523 (subtotal mastectomy) or common procedure terminology[25] codes 19120 (local excision), 19160 (partial mastectomy), or 19162 (partial mastectomy with axillary dissection). Mastectomy was defined with the following codes: ICD-9-CM procedure codes 8541 to 8542 (simple mastectomy), 8543 to 8544 (modified radical), or 8545 to 8548 (radical) or a common procedure terminology code on a physician or outpatient claim of 19240 (modified radical), 19220 (radical), or 19180 (simple mastectomy).

Analyses

Medicare claims for surgical treatment were categorized into 3 groups: mastectomy, BCS, and no cancer-directed surgery. Women were considered to have received mastectomy if any of 3 Medicare claim sources (inpatient, outpatient, or physician/supplier claims) indicated so, regardless of whether or not they had any claims for BCS. If they had claims for BCS only, they were defined as having received BCS. If they had neither claims for mastectomy nor for BCS, they were considered to have no cancer-directed surgery.

Because SEER collects only information on treatment within 4 months of the date of diagnosis,[23] we examined all Medicare claims from 1991 to 1994 for surgery that were made within 4 months (122 days) of the date of diagnosis. Because SEER reported only the month and year of diagnosis, we therefore arbitrarily defined the day of diagnosis in SEER as the 15th of the month. Date of surgery was determined from the claims source that first identified the type of surgery (mastectomy or BCS). For inpatient claims, it was defined as the date of admission. For outpatient and physician claims, it was defined as the earliest date of service.

Patient and tumor characteristics, such as age, race, tumor stage, and geographic areas, are available from the SEER data. The simple κ statistic was calculated to quantify the degree of agreement in surgical treatment categories between the 2 databases.[26] The odds ratios of concordance on surgical treatment between the 2 databases were generated from multivariate logistic regression analyses. These analyses adjusted for age, race, tumor stage, and geographic area because previous studies have found that the degree of agreement of information on treatment is affected by these factors.[8,9,11,12,20] Four metropolitan areas (San Francisco–Oakland was combined with Los Angeles County and the San Jose–Monterey area in California) and 5 states, forming 9 areas, were adjusted in the analysis. All computer programming and analyses were completed with the SAS system.[27]

Results

Table 1 presents comparisons of surgical treatment between the SEER and Medicare databases in women with breast cancer diagnosed from 1991 through 1993. Of 13,431 women having mastectomies according to the Medicare data, 95% were confirmed by SEER. For BCS, 88% of cases were confirmed by SEER. The simple κ statistic for overall agreement on surgery between SEER and Medicare was 0.75 (95% confidence interval [CI] 0.74 to 0.76). From Table 1, of the 23,709 total patients with breast cancer, in 21,299 (90%) there was information regarding surgical treatment in both SEER and Medicare. Among these patients, concordance between the 2 databases was 94%, and the κ statistic was 0.86 (95% CI 0.85 to 0.87). There was no statistically significant difference for the concordance rates between SEER and Medicare for cases diagnosed in 1991 compared with 1992 (χ^2 test, $P > 0.2$) or 1993 ($P > 0.09$).

TABLE 1. Comparison of Surgical Treatment Between SEER and Medicare Claims Made Within 4 Months of Date of Diagnosis for Women With Breast Cancer Diagnosed From 1991 to 1993

	Medicare*			
SEER	No Cancer-Directed Surgery, n (%)	BCS, n (%)	Mastectomy, n (%)	Total Row, n (%)
No cancer-directed surgery	674 (66.1)	258 (25.3)	87 (8.5)	1,019 (100.0)
	(32.6)	(3.1)	(0.7)	
BCS	477 (5.7)	7,231 (86.4)	658 (7.9)	8,366 (100.0)
	(23.1)	(88.0)	(4.9)	
Mastectomy	914 (6.4)	724 (5.1)	12,686 (88.6)	14,324 (100.0)
	(44.3)	(8.8)	(94.5)	
Total column, n (%)	2,065 (100.0)	8,213 (100.0)	13,431 (100.0)	23,709

*Claims for surgical treatment were identified from the hospital inpatient, hospital outpatient, or physician services files in the Medicare database, and only those claims for surgery made within 4 months of the date of diagnosis of breast cancer were counted here. Women were considered to have received mastectomies if any of the 3 Medicare claim sources (inpatient, outpatient, or physician claims) indicated so, regardless of whether or not they had any claims for BCS. If they had claims for BCS only, they were defined as having received BCS. If they had no claims for mastectomy or BCS, they were considered to have no cancer-directed surgery. Values are n (row %) followed by column percent.

Table 2 presents data on the accuracy of information on type of surgery in each of the 3 Medicare claims sources compared with SEER. In these analyses, we limited the analyses to cases in which information about type of surgery was available both in the particular Medicare claims source examined and in SEER. Approximately 96% of patients with mastectomy claims either in Medicare physician files or in Medicare inpatient files were confirmed by SEER. As for BCS, 91% and 88%, respectively, were confirmed by SEER. Of patients with mastectomies in Medicare outpatient files, 83% were confirmed by SEER, but only 50% of patients with BCS claims in outpatient files were confirmed by SEER. Overall agreement between Medicare and SEER was 95% for mastectomy and 91% for BCS (Table 2).

Table 3 presents the completeness of information on surgery from the different sources of Medicare claims compared with SEER. The Medicare physician services claims identified >91% of patients who received breast cancer surgery according to SEER. The Medicare inpatient claims identified 68%; the outpatient claims identified only 33%. As might be expected, the 3 sources of the Medicare claims data differed in their completeness, depending on the type of breast cancer surgery performed. The outpatient claims had data on surgery for 44% of those receiving BCS according to SEER but for only 27% of those receiving mastectomies (Table 3). The inpatient claims had data on 86% of those receiving mastectomies and only 34% of those receiving BCS. The physician claims showed similar degrees of completeness of information on surgery for patients receiving mastectomies (91%) and BCS (91%). Of 13,341 patients with mastectomies and 8,213 with BCS, 54 (0.4%) of patients with mastectomies and 166 (2.0%) patients with BCS were identified by the outpatient claims and were not identified in either the inpatient or physician claims. When the 3 claims sources were combined, 94% of surgeries according to SEER were identified by Medicare.

Table 4 presents 3 different comparisons of information on receipt of surgery between the 2 databases. The percentage of patients in whom there is agreement on receipt of surgery is given, as is the κ statistic, as a function of patient and tumor characteristics. The last column was a multivariate analysis, showing the odds of a patient having concordant information regarding receipt of surgery between the 2 databases. Concordance between the 2 data sets was significantly greater in older women and in whites. Agreement on receipt of surgery was significantly better in those with local or regional stage but much lower in those with distant or unstaged compared to those with in situ cancer. There was variation among the 9 SEER areas in the extent of concordance on type of surgery between SEER and Medicare, ranging from 81% to 90% (data not shown). When the region variables were excluded from the logistic model, the magnitude of the odds ratios for other variables changed slightly, but the direction and

TABLE 2. Accuracy of Information on Type of Surgery in the Medicare Claims Database Compared With SEER

Source of Medicare Claims	Cases With Claims for Mastectomy in Medicare Files Confirmed by SEER, % (No. Identified by SEER/No. in Medicare)*	Cases With Claims for BCS in Medicare Files Confirmed by SEER, % (No. Identified by SEER/No. in Medicare)*
Medicare physician claims	96.2 (12,096/12,580)	87.9 (7,105/8,087)
Medicare inpatient claims	96.0 (12,087/12,586)	91.3 (2,369/2,596)
Medicare outpatient claims	82.8 (231/279)	49.7 (3,612/7,269)
Three Medicare claims combined†	95.1 (12,686/13,344)	90.9 (7,231/7,955)

*The analyses are restricted to those cases in which a surgical therapy is coded in both SEER and the particular Medicare database being assessed for accuracy. As a result, denominators varied by paired comparisons (including the combined numbers at the bottom of the table).

†If there was a claim for mastectomy in any of the 3 Medicare claims sources (hospital inpatient, hospital outpatient, or physician claims files), the case was categorized as mastectomy. Otherwise, the case was categorized as BCS. Only claims for surgery made within 4 months of the date of diagnosis of breast cancer were examined to ascertain surgery status.

significance of the odds ratios remained unchanged.

Discussion

The question addressed by this study is whether the Medicare claims data provide valid information on surgical treatment for patients known to have breast cancer. This question has 2 components: one involves accuracy and the other is completeness. We examined these issues for each of the 3 sources of Medicare claims and for the combined data from all 3 sources. When we were addressing these issues, we used the SEER data as the reference group because the SEER program of the National Cancer Institute is the most authoritative source of data on cancer incidence, mortality, and treatment.[28,29] SEER was designed primarily to provide such information,[21] whereas the Medicare claims data are administrative in nature and not designed for research purposes.[1–6,11–13] In addition, the validation study showed that the results on breast cancer surgery were similar in SEER compared with the National Cancer Database of the American College of Surgeons Commission on Cancer and the American Cancer

TABLE 3. Completeness of Medicare Claims on Surgery (Mastectomy or BCS) for Women With Breast Cancer Diagnosed From 1991 Through 1993

Source of Medicare Claims	Patients With Mastectomy According to SEER Who Were Identified by Medicare Claims as Having Any Surgery* (n = 14,324), n (%)	Patients With BCS According to SEER Who Were Identified by Medicare Claims as Having Any Surgery* (n = 8,366), n (%)	Patients With Either Mastectomy or BCS According to SEER Who Were Identified by Medicare Claims as Having Any Surgery (n = 22,690), n (%)
Physician claims	13,078 (91.3)	7,589 (90.7)	20,667 (91.1)
Inpatient claims	12,314 (86.0)	2,868 (34.3)	15,182 (67.9)
Outpatient claims	3,888 (27.1)	3,660 (43.7)	7,548 (33.2)
3 Claims combined†	13,410 (93.6)	7,889 (94.3)	21,299 (93.9)

*Surgery includes either mastectomy or BCS.

†Medicare claims for surgery were identified from the hospital inpatient, hospital outpatient, or physician services files. Only claims for surgery made within 4 months of the date of diagnosis of breast cancer were examined to ascertain breast cancer surgery. If there was a claim for mastectomy in any of the claims sources, the case was categorized as mastectomy. Otherwise, the case was categorized as BCS.

TABLE 4. Comparison of Surgical Treatment Between SEER and Medicare in Women With Breast Cancer Diagnosed From 1991 Through 1993

Characteristics From SEER Registry	Medicare Versus SEER			
	Number of Patients	Simple κ (95% CI)	Concordant Cases, %	Adjusted Odds Ratio of Being Concordant (95% CI)*
All patients	23,709	0.75 (0.74–0.76)	86.8	...
Age, y				
65–74	12,902	0.71 (0.70–0.72)	84.8	1
75–84	8,408	0.79 (0.78–0.80)	88.9	1.39 (1.27–1.52)
85+	2,399	0.84 (0.82–0.86)	90.5	1.51 (1.30–1.76)
Race				
White	21,534	0.75 (0.74–0.76)	87.0	1
Black	1,342	0.73 (0.70–0.76)	84.1	0.79 (0.67–0.94)
Other	833	0.77 (0.73–0.81)	87.2	1.17 (0.90–1.53)
Cancer stage				
In situ	2,176	0.74 (0.71–0.76)	86.0	1
Local	13,546	0.77 (0.76–0.78)	88.3	1.26 (1.09–1.45)
Regional	5,051	0.70 (0.68–0.73)	88.8	1.44 (1.23–1.69)
Distant	914	0.58 (0.53–0.62)	71.8	0.39 (0.32–0.48)
Unstaged	2,022	0.68 (0.65–0.70)	79.6	0.56 (0.47–0.68)

*Odds ratios were derived from the logistic regression model, adjusted for the variables listed in the table and 9 SEER areas.

Society.[30] They found that 53.4% of women with breast cancer had mastectomies and 37.7% had BCS in SEER compared with 54.1% and 40.7%, respectively, in the National Cancer Database.[30]

In terms of accuracy, among patients for whom information on type of surgery was available from both Medicare and SEER, 95% of patients who received mastectomies according to the combined Medicare claims were confirmed by SEER. Of those who received BCS, 91% were confirmed by SEER. The Medicare physician services claims and inpatient claims were approximately equal in accuracy for type of surgery. The Medicare outpatient claims were less accurate for BCS. The concordance is greater in older women (≥75 years) and in patients with local or regional stage cancer but varies among the SEER areas.

The accuracy of Medicare data on breast cancer surgery has also been studied with different reference groups, such as reabstracted records or local cancer registry data. Fisher et al[12] compared Medicare inpatient hospitalization codes for mastectomy with that identified from the reabstracted hospital record. Of those mastectomies identified by the reabstracted record, 97% were found to have a code for mastectomy in Medicare data. However, only 33 cases were reviewed. In another study, discharge data from one hospital in New York City were compared with hospital cancer registry data. The study found a high concordance rate for mastectomy between the 2 databases.[18] Warren et al[20] described a comparison of mastectomy between Medicare and SEER in patients who underwent mastectomies only in 1992–1993. The agreement rate was 95% for inpatients and 89% for outpatients.[20] These previous studies on breast cancer surgery depended on the Medicare inpatient or outpatient claims data but did not use the physician claims data. We found in this study that information on surgery identified from the physician service claims was similar in accuracy compared with that from the inpatient claims. Only 50% of BCS from the outpatient claims could be identified by SEER. This may largely reflect clinical practice patterns because many women who had BCS in the outpatient settings for diagnostic purposes may end up with a mastectomy in hospitals. Therefore, the combined data from all 3 sources of Medicare claims should generate the most accurate information on surgery.

We also found that any single Medicare claims source did not provide complete information on surgery (Table 3), although Medicare physician claims seemed the most complete among the 3 Medicare claims sources. Medicare outpatient claims, although least complete, still identified 0.4% of patients with mastectomies and 2.0% of cases with BCS that otherwise were not identified

by either inpatient or physician claims. When the 3 claims sources were combined, 94% of patients receiving breast cancer surgery according to SEER were identified by Medicare.

A number of factors might have contributed to reduce the completeness of the Medicare data on surgery. First, information on surgery from Medicare was restricted to those who had claims within 4 months of the date of diagnosis. This made it compatible with SEER data because SEER collects information only within this period.[23] However, this might have excluded those who had late claims for surgery and thus underestimate the degree of agreement between 2 data sets. We did additional analyses extending the time frame from 4 to 12 months after diagnosis. As a result, the overall agreement between SEER and Medicare on type of surgery improved (κ=0.78 compared with 0.75 in Table 1). Second, younger patients who recently became eligible for Medicare coverage might have less complete information in Medicare claims records. Indeed, younger age was a risk factor for lack of concordance between Medicare and SEER (Table 4). Third, if patients switched their care to HMOs or received care in Veterans Affairs hospitals, they may have missing information in the Medicare claims. Finally, it may be possible that a very small proportion of patients in SEER were mismatched with the Medicare data. If this happened, those patients would not have had Medicare claims for breast cancer surgery.

As previous studies also showed, Medicare claims data on the validity of mastectomy[12] have been found to have a high level of accuracy. In this study, we demonstrated that information on mastectomy and BCS is reasonably accurate and complete for women known to have breast cancer. Hence, using Medicare claims data may overcome the limitations in ascertaining treatment from cancer registries.

This study has some limitations. First, this analysis used only the Medicare claims for women identified from the SEER data as having cancer. The accuracy and completeness of breast cancer–related procedures for non-SEER cases are unknown. It is important to note that the presence of a Medicare claim with a breast cancer–related procedure does not confirm that the woman had cancer because some procedures, such as BCS, may be used for diagnostic as well as therapeutic purposes. Second, we used the SEER data as the reference group. Although SEER provides valid information on breast cancer surgical treatment,[30] we found a number of women with breast cancer who received cancer-directed surgery according to the Medicare claims data that were not recorded in the SEER data. For example, of 1,019 patients who did not have surgery according to SEER, 345 (34%) had claims for such a surgery in Medicare (Table 1). As previous investigators[11,23,31] also demonstrated, SEER might not provide complete information on treatment because it might sometimes miss information from outpatient settings and might not record those who moved immediately after diagnosis or underwent treatment in an out-of-state facility.[32] Furthermore, this study was performed in a cohort of women who were diagnosed with breast cancer and were successfully linked with Medicare data (94% match rate).[13] Also excluded were patients enrolled in HMOs and those without coverage of both Medicare parts A and B in 1991–1993. It is unknown whether the 2 databases would agree on type of surgery for those cases excluded, particularly those that were not ascertained by SEER as breast cancer but identified by Medicare data alone. Nevertheless, there was no external validation of the information on receipt of surgical treatment to assess the accuracy of the Medicare and SEER data sources and to determine which data source is "correct." This may be achieved by reviewing the medical records for a sample of patients with breast cancer. However, all patient identifiers were removed from the final SEER-Medicare linked database for confidentiality reasons, precluding these analyses.

In conclusion, the combined Medicare claims database, which includes the inpatient, outpatient, and physician service claims, provides valid information on surgical treatment among women known to have breast cancer. The claims are a rich source of data to augment the information routinely collected by tumor registries. In particular, it provides information on receipt of medical services that can be used to examine patterns of care and follow long-term outcomes of Medicare beneficiaries.

Acknowledgments

This study used the Linked SEER-Medicare Database. The interpretation and reporting of these data are the sole responsibilities of the authors. We acknowledge the efforts of the Applied Research Branch, Division of Cancer Prevention and Population Science, National Cancer Institute; the Office of Information Services and the Office of Strategic Planning, HCFA; Information Management Services, Inc; and the SEER

program tumor registries in the creation of the SEER-Medicare Database.

References

1. **Mitchell JB, Bubolz T, Paul JE, Pashos CL, Escarce JJ, Muhlbaier LH, et al.** Using Medicare claims for outcomes research. Med Care 1994;32(suppl):JS38–JS51.

2. **Lauderdale DS, Furner SE, Miles TP, Goldberg J.** Epidemiologic uses of Medicare data. Epidemiol Rev 1993;15:319–327.

3. **Fleming C, Fisher ES, Chang CH, Bubolz TA, Malenka DJ.** Studying outcomes and hospital utilization in the elderly: The advantages of a merged data base for Medicare and Veterans Affairs hospitals. Med Care 1992;30:377–391.

4. **McBean AM, Warren JL, Babish JD.** Measuring the incidence of cancer in elderly Americans using Medicare claims data. Cancer 1994;73:2417–2425.

5. **McClish DK, Penberthy L, Whittemore M, Newschaffer C, Woolard D, Desch CE, et al.** Ability of Medicare claims data and cancer registries to identify cancer cases and treatment. Am J Epidemiol 1997;145:227–233.

6. **Whittle J, Steinberg EP, Anderson GF, Herbert R.** Accuracy of Medicare claims data for estimation of cancer incidence and resection rates among elderly Americans. Med Care 1991;29:1226–1236.

7. **Warren JL, Riley GF, McBean AM, Hakim R.** Use of Medicare data to identify incident breast cancer cases. Health Care Financing Rev 1996;18:237–246.

8. **Nattinger AB, Gottlieb MS, Hoffman RG, Walker AP, Goodwin JS.** Minimal increase in use of breast-conserving surgery from 1986 to 1990. Med Care 1996;34:479–489.

9. **Nattinger AB, Gottlieb MS, Veum J, Yahnke D, Goodwin JS.** Geographic variation in the use of breast-conserving treatment for breast cancer. N Engl J Med 1992;326:1102–1107.

10. **Simon MS, Stano M, Severson RK, Hoff MS, Smith DW.** Clinical surveillance for early stage breast cancer: An analysis of claims data. Breast Cancer Res Treat 1996;40:119–128.

11. **Du XL, Freeman JL, Goodwin JS.** Information on radiation treatment in patients with breast cancer: The advantages of the linked Medicare and SEER data. J Clin Epidemiol 1999;52:463–470.

12. **Fisher ES, Whaley FS, Krushat WM, Malenka DJ, Fleming C, Baron JA, et al.** The accuracy of Medicare's hospital claims data: Progress has been made, but problems remain. Am J Public Health 1992;82:243–248.

13. **Potosky AL, Riley GF, Lubitz JD, Mentnech RM, Kessler LG.** Potential for cancer related health services research using a linked Medicare-tumor registry database. Med Care 1993;31:732–748.

14. **Cooper GS, Yuan Z, Stange KC, Dennis LK, Amini SB, Rimm AA.** The sensitivity of Medicare claims data for case ascertainment of six common cancers. Med Care 1999;37:436–444.

15. **Warren JL, Feuer E, Potosky AL, Riley GF, Lynch CF.** Use of Medicare hospital and physician data to assess breast cancer incidence. Med Care 1999;37:445–456.

16. **Cooper GS, Yuan Z, Stange KC, Amini SB, Dennis LK, Rimm AA.** The utility of Medicare claims data for measuring cancer stage. Med Care 1999;37:706–711.

17. **Nattinger AB, Hoffmann RG, Howell-Pelz A, Goodwin JS.** Effect of Nancy Reagan's mastectomy on choice of surgery for breast cancer by US women. JAMA 1998;279:762–766.

18. **Kahn LH, Blustein J, Arons RR, Yee R, Shea S.** The validity of hospital administrative data in monitoring variations in breast cancer surgery. Am J Public Health 1996;86:243–245.

19. **Du XL, Freeman JL, Freeman DH, Syblik DA, Goodwin JS.** Temporal and regional variation in the use of breast conserving surgery and radiotherapy for older women with early stage breast cancer from 1983 to 1995. J Gerontol Med Sci 1999;54A:474–478.

20. **Warren JL, Riley GF, Potosky AL, Klabunde CN, Richter E, Ballard-Barbash R.** Trends and outcomes of outpatient mastectomy in elderly women. J Natl Cancer Inst 1998;90:833–840.

21. **Ries LAG, Kosary CL, Hankey BF, Miller BA, Harras A, Edwards BK, eds.** SEER cancer statistics review, 1973–1994. Bethesda, Md: National Cancer Institute; 1997. NIH publication No. 97-2789.

22. National Cancer Institute. The SEER program code manual. Revised ed. Bethesda, Md: National Cancer Institute; 1994. NIH publication No. 94-1999.

23. **Ballard-Barbash R, Potosky AL, Harlan LC, Nayfield SG, Kessler LG.** Factors associated with surgical and radiation therapy for early stage breast cancer in older women. J Natl Cancer Inst 1996;88:716–726.

24. US Public Health Services. International classification of diseases, 9th revision: Clinical modification. 5th ed. Los Angeles, Calif: PMIC; 1996.

25. American Medical Association. Physicians' current procedural terminology: CPT 94. Chicago, Ill: American Medical Association; 1993.

26. **Fleiss JL.** Statistical methods for rates and proportions. 2nd ed. New York, NY: John Wiley & Sons; 1981.

27. **Stokes ME, Davis CS, Koch GG.** Categorical data analysis using the SAS system. Cary, Ind: SAS Institute Inc; 1997.

28. **Wingo PA, Ries LA, Giovino GA, Miller DS, Rosenberg HM, Shopland DR, et al.** Annual report to

the nation on the status of cancer, 1973–1996, with a special section on lung cancer and tobacco smoking. J Natl Cancer Inst 1999;91:675–690.

29. **Wingo PA, Ries LA, Rosenberg HM, Miller DS, Edwards BK.** Cancer incidence and mortality, 1973–1995: A report card for the US. Cancer 1998;82:1197–1207.

30. **Mettlin CJ, Menck HR, Winchester DP, Murphy GP.** A comparison of breast, colorectal, lung, and prostate cancers reported to the National Cancer Data Base and the Surveillance, Epidemiology, and End Results Program. Cancer 1997;79:2052–2061.

31. **Farrow DC, Hunt WC, Samet JM.** Geographic variation in the treatment of localized breast cancer. N Engl J Med 1992;326:1097–1101.

32. **Mann BA, Samet JM, Hunt WC, Key CR, Goodwin JM, Goodwin JS.** Changing treatment of breast cancer in New Mexico from 1969 through 1985. JAMA 1988;259:3413–3417.

CURRICULUM VITAE

10/00

ANN BUTLER NATTINGER, MD, MPH

Office Address: Medical College of Wisconsin
Division of General Internal Medicine
(FEC-4th Fl, Suite 4200)
9200 Wisconsin Avenue
Milwaukee, WI 53226
PH: 414/456-6860
FAX: 414-456-6212
email address:anatting@mcw.edu

Social Security Number: [redacted]

Date of Birth: [redacted]

Marital Status: [redacted]

EDUCATION

1979 B.S., University of Illinois at Urbana-Champaign
1983 M.D., University of Illinois College of Medicine, Chicago
1988 M.P.H. University of Rochester School of Med & Dentistry

POSTGRADUATE TRAINING AND FELLOWSHIP APPOINTMENTS

1983-1986	Resident in Medicine, Primary Care Program in Internal Medicine Strong Memorial Hospital, University of Rochester
1986-1988	Fellow, General Medicine Unit, Strong Memorial Hospital, University of Rochester

FACULTY APPOINTMENTS

1983-1986	Assistant in Internal Medicine School of Medicine and Dentistry, Strong Memorial Hospital, University of Rochester
1986-1987	Instructor and Fellow in Internal Medicine, School of Medicine and Dentistry, Strong Memorial Hospital, University of Rochester
1988-95	Assistant Professor of Medicine, Medical College of Wisconsin
1989-	Director of Health Services Research, Div. of

	General Internal Medicine, Medical College of Wisconsin
1993-95	Assistant Professor of Health Services Research, Health Policy Institute, Medical College of Wisconsin
1995-00	Associate Professor of Medicine and Health Services Research, General Internal Medicine, Medical College of WI
1997-99	Associate Chief of General Internal Medicine
1999-	Chief of General Internal Medicine
2000-	Professor of Medicine, Medical College of Wisconsin
2000-	Director, Center for Patient Care and Outcomes Research

SPECIALTY CERTIFICATION

1984	National Board of Medical Examiners
1986	American Board of Internal Medicine

LICENSURE

New York and Wisconsin (WI#29279)

HONORS, AWARDS

1979	Summer Fellowship, The Chicago Heart Association
1980	Summer Fellowship, The Research Scholars Program University of Illinois, School of Basic Medical Sciences
1986	Lawrence E. Young Book Award, University of Rochester (Best Third Year Resident)
1990	Excellence in Attending Award, Dept. of Med., MCW
1994	Central Society for Clinical Research
1996	Division of GIM awarded "Best Teaching Service", by Medicine Housestaff
1997	Division of GIM awarded "Best Teaching Service", by Medicine Housestaff
1998	Fellow, American College of Physicians
1999	Division of GIM awarded "Best Teaching Service", by Medicine Housestaff
1999	Recipient of "The Learning Resources Innovative Educational Project Award", MCW
2000	Excellence in Attending Award, Dept. of Med., MCW

MEMBERSHIPS IN PROFESSIONAL AND HONORARY SOCIETIES

1986-present	American College of Physicians
1986-present	Society of General Internal Medicine

Offices held

1990-92 Coordinator, National Women's Caucus

1991-92 Counsellor, Midwest Region
1992-93 Chairperson-Elect, Midwest Region
1993-94 Chairperson, Midwest Region
1993-94 Co-Chair, Annual National Meeting
1994-97 National Council Member
2000-03 Secretary, National SGIM

Committees

1989 Workshop Selection Committee, National Meeting
1989 Abstract Selection Committee, Regional Meeting
1990 Fellow's Award Committee, Midwest Region
1992 Trainee Award Committee, National Meeting
1992 Trainee Award Committee, Midwest Meeting
1994 Continuing Medical Education Committee
1995 Abstract Selection Committee, National Meeting
1995-97 Education Committee
1995-97 Membership Committee
1996 Chair, Clin Epi Abstract Committee, National Mtg
1996-Development Task Force
1997 HSR abstract Committee, National Mtg
1998 HSR abstract Committee, National Mtg
2000 Glaser Award Selection Committee

1987 American Public Health Association
1988 Society for Medical Decision Making
1992 American Geriatrics Society
1994 Central Society for Clinical Research (invited)
1995-98 Council Member
1995 Association for Health Services Research
1999 Milwaukee Academy of Medicine

EDITORIAL BOARDS

1996-99 Editorial Board, Journal of General Internal Medicine
1996- Editorial Board, American Journal of Medical Sciences

Manuscript Reviewer for the Journal of General Internal Medicine, American Journal of Medicine, Annals of Internal Medicine, Journal of the National Cancer Institute, Medical Care, Cancer, American Journal of Public Health, Institute of Medicine

NATIONAL ADVISORY COMMITTEES AND/OR ACTIVITIES

1990-92 Coordinator, National Society of General Internal Medicine Women's Caucus
1993 Agency for Health Care Policy and Research. Invited participant for the program "Medical Effectiveness Research: Strategies for the Future", a discussion of the future of the PORT program. February 17-18, 1993
1993-94 Co-Chair, Society of General Internal Medicine National Annual Meeting

Co-Responsible for entire scientific program, including abstracts, workshops, precourses, mentoring program.

1993-00 American Cancer Society, national office. Member, Medical Affairs Advisory Group on Primary Care Physicians Awards. (Study section to select recipients of ACS Primary Care Physicians Career Development Awards).
- 1998-00 Chair

1994-97 Elected to National Council of the Society of General Internal Medicine. Two persons per year nationally are elected as councilors.

1997 American Cancer Society – national office. Member, Peer Review Group to conduct site visit of ACS Intramural Epidemiology & Surveillance Programs. Committee Chair: Jonathon Samet, MD.

1998 Ad Hoc Reviewer, Agency for Health Care Policy and Research small grants program.

2000-03 Secretary, National Society of General Internal Medicine

COMMUNITY ADVISORY COMMITTEES AND/OR ACTIVITIES

1989-93 American Cancer Society, Wisconsin Physician Education Subcommittee

1990-95 American Cancer Society, Wisconsin Cancer Prevention and Early Detection
- 1994 Co-Chair

1995-98 American Cancer Society, Wisconsin
- Detection Policy Task Force Committee.

1995- American Cancer Society, Wisconsin
- Research and Clinical Issues Committee

MEDICAL COLLEGE COMMITTEES

1988- Member, Cancer Center

1993-97 Women's Faculty Council
- 1994-96 Chair, Program Planning Committee
- 1995-96 Chair-elect
- 1996-97 Chair

1993-97 Faculty Welfare Committee

1994 Search Committee for Chair of Preventive Medicine

1994 Chair, Outcomes Measurement Work Group

1995 Clinical Task Force for Strategic Planning

1997-98 Board Member, Clinical Practice Group

1998-99 Chair, Medical Effectiveness Task Force

2000 General Clinical Research Center Advisory Board

2000- Rank and Tenure Committee

2000- Modern Research Direction and the Future of Medicine Group

DEPT. OF MEDICINE COMMITTEES

1992-98 Advisory Committee on Rank & Tenure

1992- Residency Curriculum Committee

1992-93 Advisory Committee on Search for GIM Div. Chief

1996-97 Research Committee

1998- Faculty Development Committee

DIVISION OF GIM COMMITTEES

1988-93 General Medical Clinic Team Leader
1989-93 Research Committee, Co-director
1989-93 Executive Committee
1993-98 Chair, Research Strategic Planning Committee
1994-97 Chair, Inpatient Education Subcommittee
1995- Management Team
1998- Research Committee

HOSPITAL COMMITTEES

1998-0 Clinical Management Committee, FMLH
1998- Hospital Advisory Committee, FMLH

INVITED PRESENTATIONS, WORKSHOPS

"Lifestyle Issues Impacting the Faculty Development of Academic Internists." Coordinator and moderator of panel discussion at the Society of General Internal Medicine National meeting, Washington, D.C., April 29, 1988.

"Prevention of Postmenopausal Osteoporosis: Are Two Hormones Better Than One?" Moderator of debate at Society of General Internal Medicine National meeting, Washington, D.C., May 1990.

"Faculty Development and Mentorship in General Internal Medicine." Panel Discussion at SGIM Midwest Regional meeting, Chicago, IL, Nov. 1990.

"Screening for Breast Cancer", presented at the Wisconsin State ACP meeting, Madison, WI, Sept. 1990.

"Breast Cancer Screening in the Elderly Woman", Lecture at the Annual Fall Conference on Geriatrics, Midwest Geriatric Education Center, Milwaukee, WI, Sept. 7, 1990.

"Mentoring in Academic General Internal Medicine: Finding and Becoming a good Academic Parent." Panel Discussion at SGIM National Meeting, Seattle, WA, May, 1991.

"Breast Cancer in the Older Woman: Barriers to Care", Medical Grand Rounds and Visiting Professor, Henry Ford Hospital, Detroit, MI, Dec, 1991.

"Working Part-time in the Academic Setting: A Viable Option?" Panel discussion at SGIM National Meeting, Washington, DC, May, 1992.

"Variation in Breast Cancer Treatment", Plenary presentation at Central Society for Clinical Research, Chicago, IL, Nov. 6, 1992.

"Women in Academic Medicine", invited presentation to Regional AMWA Student-Doctor Annual Meeting, Milwaukee, WI, Feb. 1993.

"Community Variation in Breast Cancer Treatment", Plenary presentation at University of Wisconsin Meeting:Providing Health Care to the Local Community: What Do We Need and How Do We Know It? Milwaukee, WI April 3, 1993.

"Promotion of Women in Academic Medicine", Plenary presentation, A Clinical Symposium Honoring Rudolph J. Napodano, M.D., Rochester Academy of Medicine, Rochester, NY, April 24, 1993.

"Linkage of AHA and Medpar Databases", Plenary presentation, "Linkage of Central Cancer Registries with Secondary Databases." Sponsored by National Cancer Institute and Medical College of Virginia, Richmond, VA, November 12, 1993.

"Variations in Breast Cancer Treatment", invited presentation to Regional AMWA Student-Doctor Annual Meeting, Milwaukee, WI, March 19, 1994.

"Cancer Screening in Primary Care Practice" and "Variation in the Use of Breast Conserving Surgery", 18th Annual Solomon Papper Humane Scholarship Lectures, University of Oklahoma Health Services Center, Oklahoma City, OK, March 23, 1994.

"Variations in Breast Cancer Treatment", Medical Grand Rounds, St. Luke's Hospital, Milwaukee, WI, June 9, 1994.

"Issues of Detection and Etiology", Northern Illinois Medical Center-Symposium" Cancer Challenges 1994-Breast & Prostate", McHenry, Illinois, June, 1994.

"Breast Cancer Screening and the Clinical Breast Exam", workshop presentation at SGIM National Meeting, San Diego, CA, May, 1995.

"Exploring Career and Family Dilemmas", workshop presentation at SGIM National Meeting, San Diego, CA, May, 1995.

"Breast Cancer Screening in the Older Woman", plenary presentation "Cancer in Older People", at Lake Geneva, WI, June 9, 1995.

"Breast Cancer Screening:Standards and Strategies", invited lecture at The University of Michigan Medical School, Ann Arbor, MI, April 29, 1996.

"Colorectal Cancer Screening: The Latest Poop", workshop presentation at the Midwest SGIM meeting, Chicago, IL, Sept 27, 1997.

"Update on Women's Health-1997". Invited speaker at The American College of Physicians National meeting. San Diego, CA. April 2-5, 1998.

"Career Development Awards: How To Get One", workshop presentation at the Society of General Internal Medicine National Meeting. April 23-25, 1998, Chicago, IL.

"Colorectal Cancer Screening: Clinical Update and Controversies", workshop presentation at the National Society of General Internal Medicine meetings in Chicago IL, April 23-25, 1998.

"Breast and Cervical Cancer: Where Are We Going? How Might We Get There", plenary talk at a conference Sponsored by Wisconsin Cancer Council, June 25, 1998, Oconomowoc, WI.

"How Do We Treat Women with Breast Cancer? Studies in Variation in Care", lecture at University of Chicago, Chicago, IL, July 15, 1998.

"Breast Cancer in Older Women", lecture at Wisconsin Board Review Course in Geriatric Medicine. Delavan, WI, September 23-26, 1998.

"How Do We Treat Women with Breast Cancer? Observations from Studies of Variation in Care", lecture at University of California at San Francisco, San Francisco, CA, October 26, 1998.

"Update in Women's Health – 1998". Invited speaker at the American College of Physicians national meeting. New Orleans, LA, April 22, 23, 1999.

"Breast Cancer Screening", Plenary speaker at the New York Downstate Scientific meeting of the New York ACP-ASIM Chapter. New York, NY, May 15, 1999.

"Promotion of Women in Academic Medicine," invited presentation at the Regional American Medical Women's Association meeting. Milwaukee, WI, August 21, 1999.

"Rekindling Career Passion in Mid-Life", workshop presentation at the Society of General Internal Medicine Midwest Regional Meeting. September 16-18, 1999, Chicago, IL.

"Primary Care Internal Medicine", presentation at the ACP-ASIM Preparation for Recertification in Internal Medicine Course. September 15-17, 2000, Milwaukee, WI.

RESEARCH GRANTS, CONTRACT, AWARDS

Innovation in Patient Care Program, Strong Memorial Hospital. Co-principal Investigator. Total Direct Costs: $10,200 1987-1988. "Holter Monitoring in the Patient with Focal Neurologic Deficit."

American Cancer Society Institutional Grant. Principal Investigator of Seed Grant. Total Direct Costs: $7,200 Jan. 1, 1989-Dec. 21, 1989. "Relation of Age and Ethnicity to Patterns of Treatment for Breast Cancer".

Public Health Service Grant, National Cancer Institute R01-CA54676. Principal Investigator at 40% effort. Total Direct Costs: $49,099, April 1, 1991-June 1992. "Use of Breast-Conserving Surgery in the Elderly."

Public Health Service Grant, National Cancer Institute R01-CA54676. Principal Investigator at 35% effort. Total Direct Costs: $286,271, May 24,1993-April 30, 1997. "Use of Breast-Conserving Surgery in the Elderly."

VA HSR&D #92-609. Co-Investigator at 10% effort. Total Direct Costs: $508,000, July 1, 1993-June 30, 1996. "Clinical Decision Making and Prostate Cancer." PI: Marilyn Schapira, M.D.

Department of Defense, DAMD17-94-J4043. Principal Investigator at 25% effort. Total Direct Costs $525, 667. September 1994-August 1999. "Surveillance After Initial Treatment for Breast Cancer: A Population-Based Study of Variation and Outcomes of Care".

Department of Defense DAMD17-96-6262. Principal Investigator at 25% effort. Total Direct Costs: $540,000, Sept 1996-Aug 2001. "Early Stage Breast Cancer in Older Women: Predictors and Outcomes of Therapy".

National American Cancer Society, Cancer Control Career Development Award for Primary Care Physicians. Mentor at 5% effort (donated) for award to Marilyn M. Schapira, M.D. Total Direct Costs: $140,000. July 1, 1997-June 30, 2000.

National American Cancer Society, Cancer Control Career Development Award for Primary Care Physicians. Mentor at 5% effort (donated) for award to Mary Ann Gilligan, M.D. Total Direct Costs: $165,000. July 1, 1999-June 30, 2002.

HRSA, National Research Service Award T3Z-PE10030. Co-Program Director at 10% effort. PI: Linda Meurer, MD. Total direct costs $1,308,420, July 1, 1998-June 30, 2003. "Academic Fellowship in Primary Care Research."

PHS, National Cancer Institute 1U01CA/E581773. Site Principal Investigator at 15% effort. PI: James S. Goodwin, MD. Total Direct Costs for site: $283,969, June 1, 1999 – March 31, 2003. "Regional Variation in Breast Cancer Rates in the U.S.".

PHS, National Cancer Institute RO1CA081379. Principal Investigator at 25% effort. Total Direct Costs: $525,000, July 1, 2000-June 30, 2003. "Outcomes of Older Women with Early Stage Breast Cancer."

-BIBLIOGRAPHY-

ORIGINAL PAPERS

1. Nattinger AB, Panzer RJ, Janus J. Improving the utilization of screening mammography in primary care practices. *Arch Intern Med* 1989;149:2087-2092.

2. Jablonski DF, Mosley GM, Byrd JC, Schwallie DL, and Nattinger AB. Informed consent for patient transfers to a VA Medical Center. *J Gen Intern Med* 1991;6:229-232.

3. Nattinger AB, Gottlieb MS, Veum J, Yahnke D, Goodwin JS. Geographic variation in the use of breast-conserving treatment for breast cancer. *N Engl J Med* 1992;326:1102-07.

4. Nattinger AB, Goodwin JS. Screening mammography for older women: A case of mixed messages. *Arch of Intern Med* 1992;152:922-925.

5. Janjan NA, Nattinger AB, Young MJ, Wilson JF. First year initial treatment charges for early stage vs. locally advanced breast cancer. *Breast Dis* 1993;6:27-37.

6. Wood H, Wang-Cheng R, Nattinger AB. Postmenopausal hormone replacement: Are two hormones better than one? *J Gen Intern Med* 1993;8:451-458.

7. Nattinger AB, Goodwin JS. Regional and hospital-based variation in treatment of early breast cancer. *Cancer Control* 1994;1:334-338.

8. MacKinney TG, Walters D, Bird GL, Nattinger AB. Improvements in preventive care and communication of deaf patients: Outcomes associated with a novel health care program. *J Gen Intern Med* 1995;10:133-137.

9. Tesch BJ, Wood HM, Helwig AL, Nattinger AB. Promotion of women physicians in academic medicine: Glass ceiling or a sticky floor? *JAMA* 1995;273:1022-1025.

10. Goodwin JS, Nattinger AB. Effect of season and climate on choice of therapy for breast cancer in older women. *J Amer Geriatrics Soc* 1995;43:962-966.

11. Schapira MM, McAuliffe TL, Nattinger AB. Treatment of localized prostate cancer in African-American compared to white men: Less use of aggressive therapy for comparable disease. *Med Care* 1995;33:1079-1089.

12. Nattinger AB, Gottlieb MS, Hoffmann RG, Walker AP, Goodwin JS. Minimal increase in use of breast-conserving surgery from 1986-1990. *Med Care* 1996;34:479-489.

13. Nattinger AB, Hoffmann RG, Shapiro R, Gottlieb MS, Goodwin JS. The effect of legislative requirements on the use of breast-conserving surgery. *N Engl J Med* 1996;335:1035-1040.

14. Nattinger AB, Wang-Cheng R, Sonnenberg G, Kotchen TA. Recent advances in internal medicine. *Wisconsin Medical Journal* 1996;95:871-874.

15. Michalski TA, Nattinger AB. The influence of black race and socioeconomic status on the use of breast-conserving surgery in Medicare beneficiaries. *Cancer* 1997;79:314-319.

16. Schapira MM, Meade C, Nattinger, AB. Enhanced Decision-Making: The use of a videotape decision-aid for patients with prostate cancer. *J Patient Ed Counsel* 1997;30:119-127.

17. Tesch B, Nattinger, AB. Career advancement and gender in academic medicine. *J Irish Colleges of Physicians and Surgeons* 1997;26:172-176.

18. Nattinger AB, McAuliffe TL, Schapira MM. Generalizability of the surveillance, epidemiology, and end results registry population: Factors relevant to epidemiology and health care research. *J Clin Epidemiol* 1997;50:939-945.

19. Nattinger AB, Hoffmann RG, Howell-Pelz A, Goodwin JS. The Effect of Nancy Reagan's Mastectomy on Choice of Surgery for Breast Cancer by US Women. *JAMA* 1998;279:762-766.

20. Goodwin JS, Freeman J, Freeman D, Nattinger AB. Geographic variations in breast cancer mortality: Do higher rates imply elevated incidence or poorer survival? *Am J Public Health* 1998;88:458-460.

21. Charney P, Walsh J, Nattinger AB. Update in Women's Health:1997. *Ann Intern Med* 1998;129:551-558.

22. Schapira MM, Meade C, McAuliffe TL, Nattinger AB. Information sources and professional consultations sought by men newly diagnosed with prostate cancer. *J Ca Educ* 1999;14:243-247.

23. Charney P, Walsh J, Nattinger AB. Update in Women's Health:1998. *Ann Intern Med* 1999; 131: 952-958.

24. Schapira MM, McAuliffe TL, Nattinger, AB. Underutilization of Mammography in Older Breast Cancer Survivors, *Med Care* 2000;38:281-289.

25. Du X, Freeman JL, Warren JL, Nattinger AB, Zhang D, Freeman DH, Goodwin JS. Accuracy and Completeness of Medicare Claims Data for Surgical Treatment of Breast Cancer. *Med Care* 2000, 38:719-727.

26. Nattinger AB, Hoffmann RG, Kneusel RT, Schapira MM. Relationship between appropriateness of primary therapy for early-stage breast carcinoma and increased use of breast-conserving surgery. *Lancet* 2000;356:1148-53.

27. Du X, Freeman J, Nattinger AB, Goodwin JS. The Effect of Axillary Node Dissection on Survival in Women with Early Stage Breast Cancer. Submitted, 2000.

28. Schapira MM, Lawrence WF, Katz DA, McAuliffe TL, Nattinger AB. The Effect of Treatment on Quality of Life Among Men with Clinically Localized Prostate Cancer. In press, *Med Care* 2000.

29. Schapira MM, Nattinger AB, McHorney CA. Stick Figures or Bar Graphs? A Qualitative Study of Risk Presentation Formats. Submitted, 2000.

30. Goodwin JS, Shiva S, Anderson ET, Nattinger AB, Freeman J. Nurse Case Managers Improve the Care of Older Women with Breast Cancer. Submitted, 2000.

31. Goodwin JS, Freeman JL, Mahnken JD, Freeman DH, Nattinger AB. Both Differences in Incidence and in Survival Contribute to Geographic Variation in Breast Cancer Mortality. Submitted, 2000.

EDITORIALS

Nattinger AB. Older Women, Mammography, and Mortality from Breast Cancer. *Amer J Med* 2000;108:174-175.

Nattinger, AB. Care for Breast Cancer: The Adoption of Newer Clinical Paradigms. *Med Care* 2000;38:693-695.

LETTERS TO THE EDITOR

Tesch BJ, Nattinger AB. Creative part-time faculty arrangements. *Ann Intern Med* 1994; 120:346.

Nattinger, AB. Communicating with deaf patients. *JAMA* 1995;274:794-795.

BOOK REVIEW

Nattinger, AB. Current Therapy in Adult Medicine. (4th Edition). Kassirer JP, Greene HL; eds. 1512 pages. St. Louis MO: Mosby-Year Book; 1997. *Ann Intern Med* 1998;128:611.

BOOK CHAPTERS

Nattinger AB. Colon Cancer Screening and Detection. In: Black ER, Panzer RJ and Griner P. (ed.). Diagnostic Strategies for Common Medical Problems, Philadelphia: *American College of Physicians*, 1991.

Nattinger, AB. Colon Cancer In: Black ER, Bordley DR, Tape TG, and Panzer RJ (eds) . Diagnostic Strategies for Common Medical Problems , Philadelphia: *American College of Physicians*, 1999.

Wang-Cheng R, Nattinger AB. Postmenopausal hormone replacement therapy. In: Gynecology for the Internist. *American College of Physicians*, 2000, in press.

ABSTRACTS

Nattinger AB, Panzer RJ, Janus J, Engerman J, Reiners CA. Improving the utilization of screening mammography. *Clin Res* 1988;36:747A. Presented at the Society of General Internal Medicine National meeting.

Nattinger AB, Franklin PD, Panzer RJ, Greenland P. Yield of Holter monitoring in patients with new focal neurologic deficits. *Clin Res* 1988;36:715A.

Nattinger AB, Gottlieb MJ, Rimm AA, Goodwin JS. National study of treatments for elderly women with breast cancer. *Clin Res* 1989;37:982A. Presented at the SGIM Midwest Regional meeting, November, 1989.

Nattinger AB, Gottlieb MJ, Rimm AA, Goodwin JS. Reasons for variation in the use of breast-conserving surgery for elderly women with breast cancer. A national study. *Clin Res* 1990; 38:281A. Presented at the AFCR Featured Research Symposium, May, 1990.

Heudebert GR, Young MJ, Nattinger AB. Meta-analysis of steroids in septic shock. *Clin Res* 1990;38:695A. Presented at the SGIM National Meeting, May, 1990.

Jablonski DF, Byrd JC, Nattinger AB, Mosley GM, and Schwallie DL. Informed consent in VA transfers. *Clin Res* 1990;38:739A. Presented at the SGIM National meeting. May, 1990.

Nattinger AB, Janjan N, Young MJ, Wilson JF. Reduced initial treatment charges for early stage vs. locally advanced breast cancer. Presented at RSNA meeting, November, 1990.

MacKinney TG, Walters D, Bird G, Nattinger AB. The provision of interpreters for deaf outpatients improves patient satisfaction and care. *Clin Res* 1992;40:771A. Presented at the SGIM Midwest Regional meeting, September, 1992.

Schapira MM, Nattinger AB. Understanding the poor outcome of prostate cancer in the American black population. *Clin Res* 1992;40:771A. Presented at the SGIM Midwest Regional meeting, September, 1992.

Nattinger AB, Gottlieb MS, Yahnke DP, Goodwin JS. The early adoption of breast-conserving surgery in Medicare patients: Hospital variation and the effect of hospital volume. *Clin Res* 1992;40:771A. Presented at the SGIM Midwest Regional meeting, September, 1992.

Nattinger AB, Gottlieb MS, Yahnke DP, Goodwin JS. Does where you live still determine the surgery you receive for breast cancer? *Clin Res* 1992;41:545A. Presented at the SGIM National meeting, April, 1993.

Tesch BJ, Wood HM, Helwig A, Nattinger AB. Women in academic medicine: A glass ceiling or a sticky floor? *Clin Res* 1993;41:582A. Presented at the SGIM National meeting, April, 1993.

Schapira MM, McAuliffe TL, Nattinger AB. Age and race as determinants of definitive therapy for early stage prostate cancer in the United States. *Clin Res* 1993;41:717A. Presented at the Midwest Society of General Internal Medicine meeting, September, 1993.

Schapira MM, McAuliffe TL, Nattinger AB. Race as a determinant of definitive therapy and treatment modality for early stage prostate cancer in the United States. *Clin Res* 1994. Presented at the Society of General Internal Medicine National Meeting, April 29, 1994.

Michalski TA, Nattinger, AB. Influence of socioeconomic status and black race on use of conservative surgery for breast cancer. *J Gen Intern Med* 1995;10:124. Presented at the Society of General Internal Medicine National Meeting, May, 1995.

Nattinger AB, Hoffmann RG, Gottlieb MS, Shapiro RS. Effect of laws regarding disclosure of breast cancer treatment options on the adoption of breast-conserving surgery. *J Gen Intern Med* 1995;10:74. Presented at the Society of General Internal Medicine National Meeting, May, 1995.

Nattinger AB, McAuliffe T, Schapira MM. Generalizability of SEER tumor registry patients with respect to nonclinical determinants of cancer treatment. *J Gen Intern Med* 1995;10:75. Presented at the Society of General Internal Medicine National Meeting, May, 1995.

Schapira MM, Meade C, Nattinger AB. Developing a video-tape treatment decision-aid for patients with localized prostate cancer. *J Gen Intern Med* 1995;10:52. Presented at the Society of General Internal Medicine National Meeting, May, 1995.

Schapira MM, Lamb G, Wang-Chang B, Nattinger, AB. Development of an inpatient general internal medicine teaching curriculum. Teaching Internal Medicine Symposium, Seattle, Washington, October, 1995.

Schapira MM, McAuliffe TL, Nattinger AB. Rates of surveillance testing and office visits after initial treatment for early stage breast cancer. Presented at the Regional Society for General Internal Medicine Meeting, Chicago, Illinois, September, 1996.

Schapira MM, Lawrence W, Nattinger, AB. Utility assessment of impotence and incontinence states before and after tretment for localized prostate cancer. Presented at the Society for Medical Decision-Making National Meeting, Toronto, Canada, October, 1996.

Schapira MM, Nattinger AB, McAuliffe. Underuse of surveillance mammography after breast cancer treatment in a Medicare population. Presented at the Society of General Internal Medicine National Meeting, Washington, DC, May, 1997.

Schapira MM, Lawerence W, Nattinger AB. Weighing the evidence: Sources of information used by inpatients prior to prostate cancer treatment decisions. Presented at the Society of General Internal Medicine National Meeting, Washington, DC, May, 1997.

Schapira MM, Nattinger AB, Lawrence W, Katz D. Information seeking and satisfaction with treatment decision in patients with clinically localized prostate cancer. Presented at the Regional SGIM meeting, Chicago, IL, Sept 26, 1997.

Beam CA, Nattinger AB. Accuracy of inpatient Medicare claims for breast cancer therapy determination. Presented at the Department of Defense U.S. Army Medical Research and Materiel Command Breast Cancer Research Program Meeting: An Era of Hope. Oct 31-Nov 4, 1997, Washington, DC.

Beam CA, Guse C, Nattinger AB. Do outpatient records improve the accuracy of Medicare breast cancer claims data? *J Gen Intern Med* 1998;13:41. Presented at the Society of General Internal Medicine National Meeting, April 23-25, 1998, Chicago, IL.

Schapira MM, Kneusel R, McAuliffe TL, Nattinger AB. Use of surveillance tests and office visits among older breast cancer survivors. *J Gen Intern Med* 1998;13(suppl):48.

Schapira MM, Nattinger AB, McHorney CA. Stick figures or bar graphs? A qualitative study of how risk presentation affects risk perceptions. Presented at the 15th Annual Midwest SGIM meeting, Chicago, IL, Sept. 18-19, 1998.

Nattinger AB, Hoffmann RG, Kneusel RT, Schapira MM. Decrease in appropriateness of breast cancer care associated with increased use of breast-conserving surgery. *J Gen Intern Med* 1999;14:58. Presented at the 22nd Annual National SGIM meeting in San Francisco, CA, April 29-May 1, 1999.

Boyle K, Natttinger AB, Lamb GC. The faculty-learner dyad in the outpatient setting: What is the patient's perspective? *J Gen Intern Med* 1999;14:13. Presented at the 22nd Annual National SGIM meeting in San Francisco, CA, May 29th-May 1st, 1999.

Schapira MM, Lawrence WF, Katz DA, Nattinger AB. Differences in quality of life over time in men treated with surgery, radiation, or expectant management for early stage prostate cancer. *J Gen Intern Med* 1999;14:69. Presented at the 22nd Annual National SGIM meeting in San Francisco, CA, April 29th- May 1st, 1999.

Hariharan J, Murph C, Kobmeyer K, Nattinger AB. A new twist on drug abuse. *J Gen Intern Med* 1999;14:178. Presented at the 22nd Annual National SGIM meeting in San Francisco, CA. April 29th-May 1st, 1999.

Nattinger AB, Hoffmann RG, Kneusel RT, Schapira MM. Outcomes associated with omission of radiotherapy after breast-conserving surgery, among older women with early stage breast cancer. *JGIM* 2000;15:87-88. Presented at the 23rd Annual SGIM meeting in Boston, MA. May 4-6, 2000.

Schapira MM, Nattinger AB, McAuliffe TA, Eparvier LJ. Improving the accuracy of breast cancer risk perceptions with a computer based tailored risk information intervention. *JGIM* 2000;15:95-96. Presented at the 23rd Annual SGIM meeting in Boston, MA. May 4-6, 2000.

Gilligan M, Hoffmann RG, Kneusel RT, Nattinger AB. Determinants of use of breast-conserving surgery: change over time. *JGIM* 2000;15:117. Presented at the 23rd Annual SGIM meeting in Boston, MA. May 4-6, 2000.

Lamb GC, Kupst M, Nattinger AB. How does a screening mammogram impact a woman's perception of her own health? *JGIM* 2000;15:163. Presented at the 23rd Annual SGIM meeting in Boston, MA. May 4-6, 2000.

Schapira MM, Nattinger AB. Identification of a risk magnitude bias associated with type of graphic format used to present probabilistic information. Abstract submission for the 2000 SMDM meeting in Cincinnati, OH. September 24-27, 2000.

DEPARTMENT OF THE ARMY
US ARMY MEDICAL RESEARCH AND MATERIEL COMMAND
504 SCOTT STREET
FORT DETRICK, MARYLAND 21702-5012

REPLY TO
ATTENTION OF:

MCMR-RMI-S (70-1y) 21 Feb 03

MEMORANDUM FOR Administrator, Defense Technical Information Center (DTIC-OCA), 8725 John J. Kingman Road, Fort Belvoir, VA 22060-6218

SUBJECT: Request Change in Distribution Statement

1. The U.S. Army Medical Research and Materiel Command has reexamined the need for the limitation assigned to technical reports written for this Command. Request the limited distribution statement for the enclosed accession numbers be changed to "Approved for public release; distribution unlimited." These reports should be released to the National Technical Information Service.

2. Point of contact for this request is Ms. Kristin Morrow at DSN 343-7327 or by e-mail at Kristin.Morrow@det.amedd.army.mil.

FOR THE COMMANDER:

Encl

PHYLLIS M. RINEHART
Deputy Chief of Staff for
Information Management

ADB263458
ADB282174
ADB270704
ADB282196
ADB264903
ADB268484
ADB282253
ADB282115
ADB263413
ADB269109
ADB282106
ADB262514
ADB282264
ADB256789
ADB251569
ADB258878
ADB282275
ADB270822
ADB282207
ADB257105
ADB281673
ADB254429
ADB282110
ADB262549
ADB268358
ADB257359
ADB265810
ADB282111
ADB273020
ADB282185
ADB266340
ADB262490
ADB266385
ADB282181
ADB262451
ADB266306
ADB260298
ADB269253
ADB282119
ADB261755
ADB257398
ADB267683
ADB282231
ADB234475
ADB247704
ADB258112
ADB267627
ADB282838
ADB233092
ADB263929
ADB282182
ADB257136
ADB282227
ADB282177
ADB263548
ADB246535
ADB282826
ADB282127
ADB271165
ADB282112
ADB255775
ADB265599
ADB282098
ADB232738
ADB243196
ADB257445
ADB267547
ADB277556
ADB239320
ADB253648
ADB282171
ADB233883
ADB257696
ADB232089
ADB240398
ADB261087
ADB249593
ADB264542
ADB282216
ADB261617
ADB269116